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An Improved FAST+SURF Fast Matching Algorithm

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Abstract

Target matching is an important part of image registration and mosaic. Based on a lot of real-time application requirements, the requirement of fast matching is also put forward.The classical matching algorithm has the problems of large computation and slow speed.Aiming at the problems existing in the classical algorithm, a fast matching algorithm based on the combination of FAST feature points and SURF descriptor is proposed.Experiments show that compared to the classic SIFT matching algorithm, the method is very good to achieve the goal of fast matching, in addition to the algorithm also improves the accuracy of the matching.

Keywords:Fast matching, SIFT,FAST feature points,SURF descriptor

1. Introduction

Image matching is a key technology in the field of image processing.Many scholars have done a lot of work in this area, the focus of research focused on matching accuracy and real-time, etc.

Image matching is often divided into matching based on gray correlation and image feature[1].The matching method based on gray correlation is a method which is used to search the matching image. The computation of this method is large,and it is very sensitive to image scaling and rotation[2].Based on the characteristics of the image matching method using feature information of images.For example, Harris algorithm, respectively, in the template image and the image to be matched to extract Harris corner point information.Then, the correlation coefficient is used to search the most relevant position in the image to be matched, but this method still has no scale and rotation-invariant [3].In 2004, the SIFT algorithm proposed by Lowe[4], by introducing Laplace of Gaussian operators realize the scale and rotation invariant feature points, to achieve automatic image matching, but also correspondingly increase the computing workload, can not meet the requirements of real-time.In 2006, Bay[5] proposed the SURF algorithm based on SIFT algorithm, the main direction of the calculation method using Haar wavelet feature points, can greatly

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improve the speed of image matching, while feature extraction and descriptor structure and other aspects of the improvement, but still can not meet the requirements of real-time.For the texture information rich images, Rosten proposed a more real-time FAST feature points[6], FAST feature points extracted only with the image of the gray value, and therefore does not have the scale rotation invariant.A representative feature algorithm is analyzed[7] and the SURF algorithm is proved to be the best performance algorithm.

Aiming at the problem of real-time speed of image matching, feature points are extracted by feature point detection algorithm in real-time detection and texture information of FAST algorithm, and the FAST feature points are improved by using the Laplace operator weighted[8,9], and describe the characteristics of the SURF descriptor, use the BBF[10] to match, so that it remains the rotation invariant of the SURF algorithm, and has a certain affine invariant , to achieve real-time matching requirements.

2. Fast matching algorithm design of improved FAST+SURF

In order to realize the fast matching of target extraction, using the Laplace operator on weighted FAST feature points to further optimize the feature point extraction will be strengthened, to give strong robustness SURF descriptors, in order to achieve the goal of fast matching.

2.1. Enhanced FAST feature point selection

FAST is a corner detection method, the most obvious advantage of this method is its computational efficiency.In order to improve the selection of FAST feature points, the original Gauss Laplace, and then calculate the FAST feature points, feature selection and object edge has such close relation.

$$\Delta[G_\sigma(x,y)*f(x,y)]=[\Delta G_\sigma(x,y)]*f(x,y)=LoG*f(x,y) \tag{1}$$

$$I_1=I_0+\alpha*LoG*f(x,y) \tag{2}$$

Formula (2) is the weighted coefficient of the Laplace operator， by controlling this factor to enhance the detection of the feature points.In addition, the method of FAST feature point detection is to determine a feature point by comparing a pixel difference or a sum of pixel sums on a circle centered on the pixel, and if there are consecutive N pixels larger than the threshold value of the pixel value or more If the center pixel value is smaller than the threshold, the pixel is regarded as the feature point.

$$\begin{cases} lx > lp+th \\ lx < lp-th \end{cases} \tag{3}$$

Another approach to fast extraction of FAST feature points is to detect non-feature points, which can greatly improve the detection efficiency.For example, the detection of 16 points (radius is 3 pixels circle), N take 8, then if the center point is non-feature point, then 1,5,9,13 four points do not meet the above formula, the center point is non-feature point.

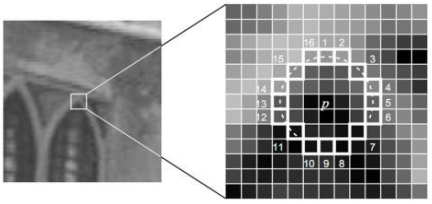

Fig. 1. FAST feature point detection