An Adaptive Harris Corner Detection Algorithm for Image Mosaic

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Abstract. Image Stitching refers to the technology fusing more than one images with overlapping part into a large field of view image. Image mosaic consists of image preprocessing, image registration and image fusion. To solve problems of serious clustering phenomenon and fewer corner points in the texture region caused by traditional Harris Corner detection algorithm, this paper proposes an improving adaptive threshold setting algorithm by calculating the second-order value of the corner response function, avoiding effects of the selection of scale factor k and threshold T on corner detection. To overcome the weakness of obvious traces in the jointing places caused by traditional weighted average method for image fusion, this paper enhances the weighted average method with trigonometric functions. Experimental results show our proposed algorithms can effectively eliminate the gap generated by image mosaic, with a better speed and precision.

Keywords: Image Stitching, Image Registration, Corner Detection, Image Fusion.

1 Introduction

Image Stitching [1] refers to the technology fusing more than one images with overlapping part into a large field of view image. Nowadays, with the popularization of the intelligent equipment, the high definition and wide-angle image is becoming increasingly urgent. Image Stitching technology, known as one of the newest achievements in the image processing, has gained lots of attentions from researchers and is developing at a high speed recent years. Image Stitching technology has played an important role in aeronautics, astronautics, geological exploration, video session, medicine and military, and also stands as a hotspot in computer visual analogue, computer effects and augmented reality research [2,3,4,5,6].

Image mosaic consists of image preprocessing, image registration and image fusion [7]. As the base of image mosaic is the preprocessing, cores are the registration and fusion, deciding the precision, speed and visual quality. The image mosaic is divided into registration based on feature and registration based on gray level, depending on the image information used in registration. The registration based on feature [8] shows stronger adaptability in gray level transformation, deformation and

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exposure discrepancy, which additionally can locate the matching positions easily and accurately. Although with highly accuracy, the one on gray level, which is also named as correlation matching algorithm, is hard to meet the demand of instantaneity because of its large computation and complexity [9]. The normal features of the registration are points, lines, close-contoured and other advanced ones such as Gaussian Sphere [10]. More attentions are attracted by registration based on feature points on account of its characteristics as being easily for fetching and less sensitive from image deformation. In the field of registration on feature points, the Harris Corner Detection algorithm [11] is famous for its high stability and robustness, but it has failed to consider the impact of the selection for the scale factor k and the threshold T of the algorithm. This paper proposes an improved Harris algorithm for this. While the traditional weighted average method is intuitionistic, fast, and less sensitive from discrepancy of exposure, shutter phenomenon [12] appears if there exists objects in the overlap region, we enhances weighted average method with trigonometric functions for image fusion, effectively reducing the obvious traces in the image splicing place.

2 Pipeline for Image Mosaic

Image Mosaic consists of image preprocessing, image registration and image fusion. For the possibility that there will be some effects from image rotation, image scaling and disparity of exposure, images are needed to be preprocessed before registration, whose keys are speed and precision. Finally images are stitched into one, in which no obvious traces are allowed for a good result. Figure 1 shows how the process flows.

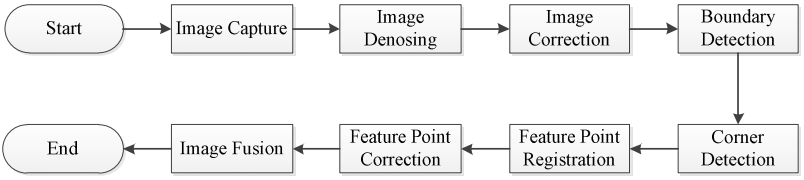

Fig. 1. Flow chart for image mosaic

2.1 Image Preprocessing

Because of the flaw on image obtaining equipment and noise from outer condition, images are interfered during the digitization and transmission, resulting in the noisy output. Median filter is often used to denoise the image. As a nonlinear smoothing technique, it can help maintain the boundary information effectively. The principle of median filter is to replace the value of specified point with the mid-value of its neighborhoods, making the surrounding pixels close to the real value, thus eliminating the isolated noise points. Median filter is calculated as formula 1.

$$g(x,y) = med\{f(x-k, y-l)\}, (k,l \in W) \quad (1)$$

In formula 1, $f(x,y)$, $g(x,y)$ stand for the original image and the processed respectively. W is the two-dimension template, usually regions of $2 \times 2, 3 \times 3$ are