

International Journal of Advance Research in Computer Science and Management Studies

Research Article / Paper / Case Study

Available online at: www.ijarcsms.com

Review on Image Mosaicing based on phase Correlation and Harris Algorithm

Kanchan S. Tidke¹

Student, Dept. of EXTC

G.H.R.C.E & M

Amravati – India

S. J. Banarase²

Faculty, Dept. of EXTC

G.H.R.C.E & M

Amravati – India

Abstract: Image mosaic is a technique used to stitch number of images taken sequentially when image capturing devices is not capable to accommodate within a single frame. In this paper we intend to investigate one of the methods for image mosaicing based on two combined technique. The method which is used here makes use of Harris corner detection along with phase correlation algorithm, which is one of the well known techniques for corner detection and Normalized Cross-Correlation (NCC). The experimental results show that, this kind of approach reduces the mosaic time compared to SIFT (Shift-Invariant feature transform) algorithm and also gives better efficiency. Also we would like to increase accuracy and reduce the time to mosaic the images by using Harris corner detection method along with phase correlation algorithm.

Keywords: mosaic, corner detection, phase correlation, NCC, SIFT.

I. INTRODUCTION

In day to day life and work sometimes there is a need for wide angle and high resolution panoramic images, which the ordinary camera equipment cannot reach. However, it is not feasible as far as the issues like whole scene, professional photographic equipment, high price of maintenance convenient for operation, lack of technical personnel and unsuitability of general uses are concerned, and hence the use of image mosaicing techniques has been put forward. Currently the image mosaicing technique has become the popular computer graphics research. Also image mosaic has been efficiently and precisely applied to areas such as industry, military, and health care. Technique of image mosaic for restoring images with larger visual angle and more reality plays an essential role in detecting more information from the image. In fact, to the limit of objective conditions, i.e. equipment or weather, images are usually unable to reflect the full scene, which makes it more difficult for the further processing of those images. The general task of image mosaic is to build the images in way of their aligning series which overlaps in space. Compared with single images, scene images built in this way are usually of higher resolution and larger vision.

Image mosaic is a technique used to composite two or more overlapped images into a seamless wide-angle image through a series of processing and it is widely used in remote sensing areas, military applications, etc. When taking these photos, it's difficult to make a precise registration due to the differences in rotation, exposure and location.

Image mosaic aims to combine a set of images, normally overlapped, to form a single image as shown in the following figures.

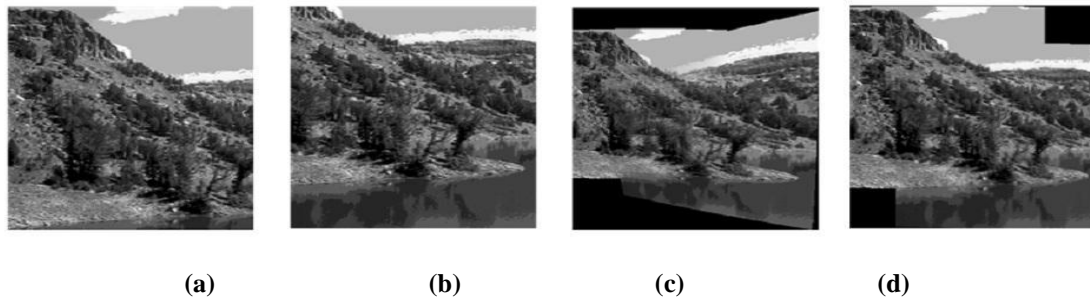


Figure 1. An overview of Image Mosaicing (a) First input image (b) Second input image (c) & (d) Mosaiced images by different mosaic techniques.

Figure (a) and Figure (b) are the input images, while Figure (c) and Figure (d) are mosaiced images. The image mosaic techniques are widely used in remote sensing, medical imaging, and military purposes and so on. Now days, many smart phones are equipped with the mosaicing application which helps user in many different ways. The image mosaicing technique can be broadly classified into feature-based and frequency-based techniques. Feature-based method uses the most similarity principle among images to get the parameters with the help of calculation cost function. Method based on the frequency domain transforms the image from spatial domain to frequency domain, and get the relationships of translation, rotation and zoom factor through Fourier transformation. In frequency domain there are methods like phase-correlation, Walsh transform, etc.

In this work we have used a technique which combines both namely the feature-based method and frequency-domain method for image Mosaicing. The feature-based method used is the Harris corner detection and the frequency-domain method used is the Fourier transform-based cross-correlation or phase correlation method.

II. REVIEW ON LITERATURE

The original image alignment algorithm was the Lucas-Kanade algorithm. The goal of Lucas-Kanade is to align a template image to an input image, where is a column vector containing the pixel coordinates. If the Lucas-Kanade algorithm is being used to compute optical flow or to track an image patch from time to time, the template is an extracted sub-region (a window, maybe) of the image [1].

Algorithms for aligning images and stitching them into seamless photo-mosaics are among the oldest and most widely used in computer vision. Frame-rate image alignment is used in every camcorder that has an “Image Stabilization” feature. Image stitching algorithms create the high- resolution photo-mosaics used to produce today’s digital maps and satellite photos. They also come bundled with most digital cameras currently being sold, and can be used to create beautiful ultra wide-angle panoramas.

An early example of a widely used image registration algorithm is the patch-based translational alignment (optical flow) technique developed by Lucas and Kanade [1]. Variants of this algorithm are used in almost all motion-compensated video compression schemes such as MPEG [3]. Similar parametric motion estimation algorithms have found a wide variety of applications, including video summarization [4][5], video stabilization [8], and video compression [9][10]. More sophisticated image registration algorithms have also been developed for medical imaging and remote sensing. In the photogrammetric community, more manually intensive methods based on surveyed ground control points or manually registered tie points have long been used to register aerial photos into large-scale photo-mosaics [11]. One of the key advances in this community was the development of bundle adjustment algorithms that could simultaneously solve for the locations of all of the camera positions, thus yielding globally consistent solutions [12]. One of the recurring problems in creating photo-mosaics is the elimination of visible seams, for which a variety of techniques have been developed over the years [13]-[17].

In film photography, special cameras were developed at the turn of the century to take ultra wide-angle panoramas, often by exposing the film through a vertical slit as the camera rotated on its axis [18]. In the mid-1990s, image alignment techniques

were started being applied to the construction of wide-angle seamless panoramas from regular hand-held cameras [19]-[22]. More recent work in this area has addressed the need to compute globally consistent alignments [23]-[25], the removal of “ghosts” due to parallax and object movement [26][27], and dealing with varying exposures [28]. (A collection of some of these papers can be found in [29].) These techniques have spawned a large number of commercial stitching products [30][31], for which reviews and comparison can be found on the Web.

While most of the above techniques work by directly minimizing pixel-to-pixel dissimilarities, a different class of algorithms works by extracting a sparse set of features and then matching these to each other [32]-[37]. Feature-based approaches have the advantage of being more robust against scene movement and are potentially faster, if implemented the right way. Their biggest advantage, however, is the ability to “recognize panoramas,” i.e., to automatically discover the adjacency (overlap) relationships among an unordered set of images, which makes them ideally suited for fully automated stitching of panoramas taken by casual users [33].

By the year 2011, at University of Victoria, Canada in Department of Electrical and Computer Engineering, Ioana S. Sevcenco, Peter J. Hampton and Pan Agathoklis proposed a method of seamless stitching of images based on a haar wavelet 2d integration [38]. Recently, Chengcheng Liu and Yong Shi proposed SIFT algorithm for image registration. SIFT algorithm is obtained by judging the feature points of local extreme, combined with neighborhood information to describe the feature points to form a feature vector, in order to build the matching relationship between the feature points.

According to the comparison and analysis above, aiming at the mosaic between images that have larger scale difference, we try to synthesize the advantages both in frequency dispose and registration with features, a new robust method combined the phase-correlation and Harris corner is proposed. We can get the factor of translation and zoom by cross-power spectrum in order to optimize the detection of Harris. The feature detection then can be restricted in the overlapped area to avoid the waste of resource in irrelevant area when we do the search work. More importantly, this method can eliminate the non-adaptive weakness because of scale change. It is superior to SIFT and original Harris algorithm in terms of the calculation speed and applicability.

III. PROBLEM DEFINITION

By keeping following things in mind as an objective, we are expecting best results from this approach of mosaicing.

- To propose a better mosaicing method, which can stitch scattered images together of the same scene (or target), so as to restore an image (or target) without losing a prior information in it.
- To increase accuracy and reduce the time to mosaic the images which will shows better efficiency as compared to other mosaicing techniques.

IV. SYSTEM MODEL DESCRIPTION

In order to improve the method of harris corner, we present an auto-adjusted algorithm of image size based on phase-correlation. First, we detect the zoom relationship and translation co-efficiency between the images and modulate the unregistered image's scale to the same level as the original image. We obtain the Region of Interest (ROI) according to the translation parameter and then pre-treat the images and mark the interest points in the area by using improved Harris corner operator. Secondly, we adopt Normalized Cross-Correlation (NCC) to wipe out the mismatched points preliminary after edging process, and get the final precise transformation matrix. At last, we are using a method of weighted average to obtain a smooth mosaic image. The experimental results have shown that the setting of ROI and handling of the edge could cut the time down to about only half of the time consuming compared to SIFT. Besides, the scale difference between the images could enlarge from 1.8 to 4.7 and can eventually obtain a clear and stable mosaic result.

The translation, scale and rotation in the available set of images are handled in the following way. Initially Phase correlation algorithm is used to calculate the cross-power spectrum for registration of images and is used to get the translation factor. For images that have relative relationships in location and scale, we can also get the zoom factor and rotation angle through a series of coordination transform.

Feature extraction method: The original Harris corner detection method has some disadvantage that, even though it is robust to the illumination changes and rotations, it is very sensitive to the variation of image size. In addition, by doing a direct corner checking to images whose textures are dense or who have abundant details, we surely would get duplicate features in a local area. Inevitably, we must do extra work to extract and registration the points, including the useless ones. So additional preprocessing the image before extraction can offer a possibility to get more stable features. The improvement is done in the following way:

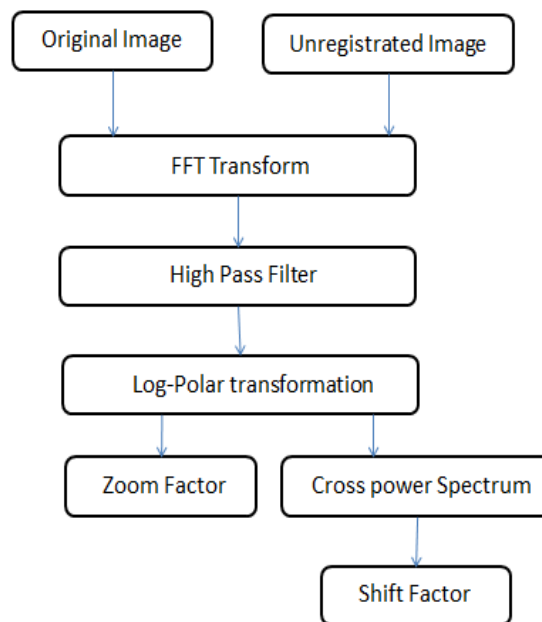


Figure 2: Flowchart to compute the factors

Step 1: Get the shift and zoom factors with the help of phase correlation calculation.

Step 2: Modulate the unregistered image according to the zoom factor obtained from step 1 to get a couple of images with the same size.

Step 3: Ascertain the ROI (Region Of Interest) between the images.

Step 4: Preprocess image before other works. The edge detection can reduce the search area and can greatly cut the matching-time down.

V. CONCLUSION

An approach for image mosaic based on phase-correlation and Harris operator is obtained through this paper. First the scaling and translation relationship is gained according to the correlation method known as phase-correlation. Then the unregistered image is adjusted and the ROI scope of matching is kept limited all according to the factors derived. Finally the feature points are detected and matched just in this area, based on the improved Harris corner. We comprehensively apply the advantages of spatial and frequency domain to conquer Harris's maximum inadequacies for not possessing the scale-invariant quality, and also we have enhanced robustness. As a result, the setting of ROI and adoption of preprocessing avoid the useless extraction and registration which leads to additional speed-ups and improvement of the precision.

References

1. Lucas, B. D. And Kanade, T. (1981). "An iterative image registration technique with an application in stereo vision". In Seventh International Joint Conference on Artificial Intelligence (IJCAI-81), pages 674–679.
2. Brown, L. G. (1992). "A survey of image registration techniques". *Computing Surveys*, 24(4), 325–376.
3. D. Le Gall, "MPEG: A video compression standard for multimedia applications," *Communications of the ACM*, vol. 34, no. 4, pp. 44–58, April 1991.
4. J. R. Bergen, P. Anandan, K. J. Hanna, and R. Hingorani, "Hierarchical model-based motion estimation," in *Second European Conference on Computer Vision (ECCV'92)*, (Santa Margherita Liguere, Italy), pp. 237–252, Springer-Verlag, May 1992.
5. M. Irani and P. Anandan, "Video indexing based on mosaic representations", *Proceedings of the IEEE*, vol. 86, no. 5, pp. 905–921, May 1998.
6. R. Kumar, P. Anandan, M. Irani, J. Bergen, and K. Hanna, "Representation of scenes from collections of images," in *IEEE Workshop on Representations of Visual Scenes*, (Cambridge, Massachusetts), pp. 10–17, June 1995.
7. L. Teodosio and W. Bender, "Salient video stills: Content and context preserved," in *ACM Multimedia 93*, (Anaheim, California), pp. 39–46, August 1993.
8. M. Hansen, P. Anandan, K. Dana, G. van der Wal, and P. Burt, "Real-time scene stabilization and mosaic construction," in *IEEE Workshop on Applications of Computer Vision (WACV'94)*, (Sarasota), pp. 54–62, December 1994. IEEE Computer Society.
9. M. Irani, S. Hsu, and P. Anandan, "Video compression using mosaic representations" *Signal Processing: Image Communication*, vol. 7, pp. 529–552, 1995.
10. M.-C. Lee et al., "A layered video object coding system using sprite and affine motion model," *IEEE Transactions on Circuits and Systems for Video Technology*, vol. 7, no. 1, pp. 130–145, February 1997.
11. C. C. Slama, ed., *Manual of Photogrammetry*. Fourth Edition, Falls Church, Virginia, 1980. American Society of Photogrammetry.
12. B. Triggs et al., "International Workshop on Vision Algorithms," in *Bundle adjustment – a modern synthesis*, (Kerkyra, Greece), pp. 298–372, Springer, September 1999.
13. A. Agarwala et al., "Interactive digital photomontage," *ACM Transactions on Graphics*, vol. 23, no. 3, pp. 292–300, August 2004.
14. J. Davis, "Mosaics of scenes with moving objects," in *IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'98)*, (Santa Barbara), pp. 354–360, June 1998.
15. D. L. Milgram, "Computer methods for creating photomosaics," *IEEE Transactions on Computers*, vol. C-24, no. 11, pp. 1113–1119, November 1975.
16. D. L. Milgram, "Adaptive techniques for photomosaicking," *IEEE Transactions on Computers*, vol. C-26, no. 11, pp. 1175–1180, November 1977.
17. S. Peleg, "Elimination of seams from photomosaics," *Computer Vision, Graphics, and Image Processing*, vol. 16, pp. 1206–1210, 1981.
18. J. Meehan, *Panoramic Photography*. Watson-Guptill, 1990.
19. S. E. Chen, "QuickTime VR – an image-based approach to virtual environment navigation," *Computer Graphics (SIGGRAPH'95)*, pp. 29–38, August 1995.
20. S. Mann and R. W. Picard, "Virtual bellows: Constructing high-quality images from video," in *First IEEE International Conference on Image Processing (ICIP-94)*, (Austin), vol. I, pp. 363–367, November 1994.
21. R. Szeliski, "Image mosaicing for tele-reality applications," in *IEEE Workshop on Applications of Computer Vision (WACV'94)*, (Sarasota), pp. 44–53, IEEE Computer Society, December 1994.
22. R. Szeliski, "Video mosaics for virtual environments," *IEEE Computer Graphics and Applications*, vol. 16, no. 2, pp. 22–30, March 1996.
23. H. S. Sawhney and R. Kumar, "True multi-image alignment and its application to mosaicing and lens distortion correction," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 21, no. 3, pp. 235–243, March 1999.
24. H.-Y. Shum and R. Szeliski, "Construction of panoramic mosaics with global and local alignment," *International Journal of Computer Vision*, vol. 36, no. 2, pp. 101–130, February 2000, Erratum published July 2002, vol. 48, no. 2, pp. 151–152, 2000.
25. R. Szeliski and H.-Y. Shum, "Creating full view panoramic image mosaics and texture-mapped models," in *Computer Graphics (SIGGRAPH'97 Proceedings)*, pp. 251–258, August 1997.
26. J. Davis, "Mosaics of scenes with moving objects," in *IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'98)*, (Santa Barbara), pp. 354–360, June 1998.
27. M. Uyttendaele, A. Eden, and R. Szeliski, "Eliminating ghosting and exposure artifacts in image mosaics," in *IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'2001)*, (Kauai, Hawaii), vol. II, pp. 509–516, December 2001.
28. A. Levin, A. Zomet, S. Peleg, and Y. Weiss, "Seamless image stitching in the gradient domain," in *Eighth European Conference on Computer Vision (ECCV 2004)*, (Prague), vol. IV, pp. 377–389, Springer-Verlag, May 2004.
29. R. Benosman and S. B. Kang, eds., *Panoramic Vision: Sensors, Theory, and Applications*. New York: Springer, 2001.
30. S. E. Chen, "QuickTime VR – an image-based approach to virtual environment navigation," *Computer Graphics (SIGGRAPH'95)*, pp. 29–38, August 1995.
31. H. S. Sawhney et al., "Videobrush: Experiences with consumer video mosaicing," in *IEEE Workshop on Applications of Computer Vision (WACV'98)*, (Princeton), pp. 56–62, IEEE Computer Society, October 1998.
32. F. Badra, A. Qumsieh, and G. Dudek, "Rotation and zooming in image mosaicing," in *IEEE Workshop on Applications of Computer Vision (WACV'98)*, (Princeton), pp. 50–55, October 1998. IEEE Computer Society.

33. M. Brown and D. Lowe, "Recognizing panoramas," in Ninth International Conference on Computer Vision (ICCV'03), (Nice, France), pp. 1218–1225, October 2003.
34. D. Capel and A. Zisserman, "Automated mosaicing with super-resolution zoom," in IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'98), (Santa Barbara), pp. 885–891, June 1998.
35. T. J. Cham and R. Cipolla, "A statistical framework for long-range feature matching in uncalibrated image mosaicing," in IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'98), (Santa Barbara), pp. 442–447, June 1998.
36. P. F. McLauchlan and A. Jaenicke, "Image mosaicing using sequential bundle adjustment," *Image and Vision Computing*, vol. 20, nos. 9–10, pp. 751–759, August 2002.
37. I. Zoghalmi, O. Faugeras, and R. Deriche, "Using geometric corners to build a 2D mosaic from a set of images," in IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR'97), (San Juan, Puerto Rico), pp. 420–425, June 1997.
38. Ioana s. sevcenco, peter j. hampton and pan agathoklis "Seamless stitching of images based on a haar wavelet 2d integration method", department of electrical and computer engineering university of victoria, Canada.

AUTHOR(S) PROFILE



Ms. Kanchan S. Tidke, has received her B.E. degree in Electronics & Telecommunication Engineering from PRMIT&R, Badnera, Amravati, India in 2010 and now she is pursuing ME in EXTC branch from G.H.Raisoni college of Engineering & Management, Amravati. Her area of interest includes Image processing.



Prof. Ms. Snehal Banarase, has received his M.Tech. degree in EXTC from MGM, Nanded, India. She has published two international papers. Currently she is working as Assistant Professor at G.H. Raisoni college of Engineering & Management, Amravati, India.