# Cylindrical Panorama Stitching Based on a Common Camera

Xue Leng

School of Photoelectric Engineering, Changchun University of Science and Technology, Changchun, 130000, China

lengxue79@126.com

**Keywords:** cylindrical panorama, match, merge, mosaic

**Abstract.** Panorama mosaic technology is an important research content in image rendering technology, it can express the complete information on the surrounding environment. As the cylindrical panorama with excellent visual effects, and accord with people's habits of observation, therefore be studied by many researchers. This article on the basis of the theory of understanding panorama, proposed a cylindrical panorama stitching technique based on common camera,and through experiments to verify the feasibility of this method.

## 1. Introduction

Panorama stitching technology mainly through the image stitching, to achieve the scene looking around. Panorama stitching technique using a camera pan or rotate an image obtained samples of partially overlapping, through computer matching, synthesis of a seamless and high-definition wide-angle picture, it has a higher resolution than the single image and a larger Perspective. Which has a very wide use in practical use.

## 2. Panorama Stitching Method

### 2.1 Obtain image

There are three general situations when the camera takes. Rotate camera to take a photograph. In this case, the camera tripod placed in the photographing process has been in the same location. When shooting, the camera rotation around the vertical axis, each rotated by a certain angle, take a picture. Ideally, the camera does not rotate around the axis of the camera.

### 2.2 Image enhancement

Image target gray tend to be concentrated in the dynamic range narrower range, by piecewise linear transformation to a narrow target range broadening distribution to enhance the contrast between target and background, and then identify the object of interest from the image.

$$g(x,y)=\begin{cases} k_1 f(x,y), 0<f(x,y)<f_1 \\ k_2\left[f(x,y)-f_1\right]+g_1, f_1<f(x,y)<f_2 \\ k_3\left[f(x,y)-f_2\right]+g_2, f_2<f(x,y)<f_M \end{cases} \quad (1)$$

$$k_1 = g_1 / f_1 \quad (2)$$

$$k_2 = (g_2 - g_1)/(f_2 - f_1) \quad (3)$$

$$k_3 = (g_M - g_2)/ f_M - f_2 \quad (4)$$

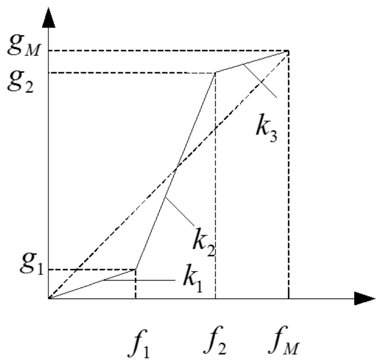


Fig.1 Piecewise linear transformation


Fig.2 Enhanced image

**2.3 Image denoising**

Median filtering with a window won the image scanned, the image pixel window contains grayscale liter (or descending) order lined up, take the middle gray value pixel gray for the window center pixel grayscale, It completes the median filter. It formulated the following formula.

$$g(m,n) = Median\{f(m-k,n-l),(k,l) \in w\} \tag{5}$$

Typically the number of pixels within the window is odd, in order to have intermediate pixels. If the number of pixels in the window is even, the median two-pixel averaging intermediate gray.

**2.4 Image conversion**

Cylindrical projection transformation is to shoot obtained reflect their projection plane overlay image is mapped to a standard to obtain the cylindrical projection on the cylindrical projection image.

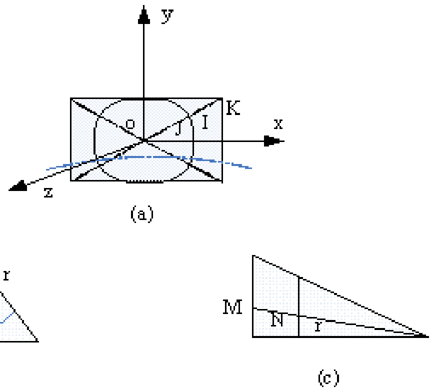


Fig.3Projection Transformation

Assuming that all of the camera motion occurs in the XZ plane to the original input image corresponding to the viewing direction is the Z-axis, where the original input image plane of view of the XY plane, that is the intersection of the optical axis coordinate dot image plane, and the original calibration of the input image I, as a cylindrical projection image calibration J, nominally cylindrical projection K, the observation point calibration is O (center of projection). To get O point observation image I projected on a cylinder K cast like J. Let cylinder radius is r, the projection angle is B, the image width W, and height H. It is easy to get a cylindrical image width is $2r \cdot \sin\theta/2$ , the height is still H.

(B) and (c) are observed transverse direction (plane) and vertical viewing direction (plane) of the cylindrical projection schematic view calibration points corresponding to the two original input image and the cylindrical projection image on the M and N positional relationship, and the radius of the cylindrical projection, the situation is a lateral viewing angle and vertical viewing angle of P.

$$\begin{cases} x_1 = r\cdot\sin\dfrac{\theta}{2} + r\cdot\sin\left[\tan^{-1}\left(\dfrac{x-\dfrac{W}{2}}{r}\right)\right] \\ y_1 = \dfrac{H}{2} + \dfrac{r\cdot(y-\dfrac{H}{2})}{k} \end{cases} \tag{6}$$

$$r = \frac{w}{2\cdot\tan\dfrac{\theta}{2}} \tag{7}$$

$$k = \sqrt{r^2 + (\frac{W}{2} - X)^2} \tag{8}$$

Where $\theta$ is uniquely identified by the angle occupied by each image point of view, is closely related to the focal length of the shooting, a panoramic view angle is 360 degrees, the image corresponding to each angle is very easy to determine. Generally $\theta$ can be approximated as in formula. Overlapping images total

$$\theta = \frac{360}{overlappingimagestotle} \tag{9}$$


Fig.4 The original image  Fig.5 Cylindrical projection  Fig.6 Fusion image

Cylindrical projection inverse transform is the inverse cylindrical projection transformation can be deduced from the inverse transform formula based on cylindrical projection cylindrical projection conversion formula.

**2.5 Image Fusion**

Image fusion technology can be divided into three levels: Pixel fusion, feature fusion and decision fusion. In this paper, using the weighted average method for image fusion, it belongs to the pixel integration. Let A(x, y) is an image pixel of image A, b(X,Y)is a correspondingly pixel in image B. the fusion image is F

$$F(x,y) = \omega_1 A(x,y) + \omega_2 B(x,y) \tag{10}$$

$$\omega_1 = \frac{A(x,y)}{A(x,y)+B(x,y)} \tag{11}$$

$$\omega_2 = 1 - \omega_1 \tag{12}$$

$\omega_1, \omega_2$ are weighting coefficients for the pixel inoverlapping areas. Through reasonable choice of weighting coefficients, we can get the ideal fusion effect, achieve seamless splicing. Experimental results were as Fig.6:

**2.6 Panorama Expansion**

In this paper, the image is to use a digital camera to take photos in order to achieve accurate splicing of adjacent two images when taking pictures, the camera will be fixed on a tripod, bracket about the axis of rotation, to avoid the camera lens of partial rotation oblique and pitch, to ensure that the level of the center line of pictures taken with the camera focus center at the same horizontal plane. When an object farther objects, allowing the camera with a slight offset. Between two adjacent images, there must be 30% -50% overlap. To facilitate image stitching, shooting, requested by the captured image of the scene is static. We shot one week ring the number of images is 13. After panorama stitching Figure 7.

Fig.7 stitching panorama

## 3. Summary

From the above figure we can see the results very satisfactory splice. On the treatment effect, when the better quality of the image itself, the algorithm can achieve accurate matching stitching, smooth boundary quite perfect. Sometimes due to image degradation caused by shot (image dim or too bright), but as long as a certain extent, the algorithm can accurately splicing, indicating that the algorithm has a certain immunity. Shooting is under substantially the same lighting conditions, for there are still significant differences in brightness of the image we do image preprocessing, avoiding the algorithm to allow two stitching big difference in luminance image.

## References


[1] LIU Bo-Chao, Zhao Jian, SUN Qiang, Improved Harris Corner Detection Method Based on Edge, Chinese Journal of Liquid Crystals and Displays, Vo1.28 (2013) No.6, P.939-942.

[2] Tangy Shuo, Miao Yuan, An image matching algorithm based on Harris corner, Image Processing and Multimedia Technology, Vo1.32 (2013) No.2, P41-43.

[3] Zhou Long Ping, Corners Detection Based on Improved Harris Algorithm, Computer Technology and Development, Vol.23 (2013) No.2, P11-14.

[4] Ruanqin, Penggang.Study on Image Registration and Mosaic Technology Basedon Surf Feature, Computer and Digital EngineeringVol22 (2013) No2, P141-144.

[5] Brauers Johannes, Aach Til. Geometric calibration of lens and filter distortions for multispectral filter-wheel cameras, Optics and Later Technology.Vol.20 (2012) No2 P496-506.