VFX Project 2 Image Stitching

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Cylindrical projection

After taken the images from the camera, we first down sample them with a scale factor of 0.1 and feed them to the Autostitch program to obtain the focal length of each images.

When the focal lengths for every image are generated, we feed the each image and its corresponding focal length to the cylindrical projector to obtain the projected image.

The method used for the projection is based on slide 34, lec07. The parameter s is set to the same value as *f* (focal length) to reduce distortion.

To obtain the projected image, inverse warping is used. However, we did not use bilinear interpolation but simply find the nearest pixel to the point calculated by inverse warping to place into the desired position.

Harris Corner Detector

There are 5 main procedures in Harris corner detection.

1. *Compute derivatives*
   We used the Sobel filter with kernel size of 5 to compute the derivatives in the x-direction and y-direction.

2. *Compute products*
   By multiplying the derivatives, the coefficient needed for the stages afterward will be obtained.

3. *Compute product of sums*
   We computed the product of sums of each pixel with a Harris window of size 3.

4. *Compute response*
   After calculating the eigenvalues for each pixel, its response can be computed using the formula on slide 40, lec06. The parameter *k* is set to 0.04.

5. *Compute local maxima*
   Finally, to obtain the features of an image, we try to find the local maxima by sweeping through the image with a window of size 7. If the pixel in the middle of the window has the greatest value among all the pixel inside the window, it is considered a local maxima. We choose the first 512 local maxima as features.

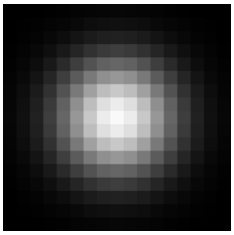
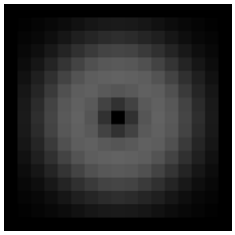
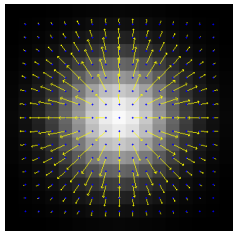
MOPS Descriptor

There are 5 main procedures in MOPS descriptor extraction.

1. *Compute orientation*

In order to figure out orientation, we need to produce the theta and magnitude map of each pixel. To show our result more clearly, we take image of 2D-gaussian as example.

In our case, after Gaussian 5*5 filter smoothing, we count the theta of the point's window (9*9) as 36 bins from 0-9 to 350-359 with weighting function, magnitude and Gaussian 9*9 filter.

2D-gaussian	magnitude	theta	orientation
			

2. *Extract key point feature*

The feature extracting principle follows the MOPS, and we also try the relatively small scale (only 5*5) with respect to 40*40 windows in MOPS. And our result shows that small scale feature performs not bad.

Feature Matching

1. *Homograph*

Homograph matrix makes more robust transformation between two images as opposed to common 2D displacement. However, we found that after focal length distortion, the homograph shows the distortion decreased to almost zero. It proves that our projection's correctness and also simplifies our transforming effort.

2. *RANSAC*

Our RANSAC has 4 input points each iteration due to the homograph method. After figuring out the candidate model, it takes Euclidean distance as error function with tolerance 0.5 and confidence 0.95.

3. *Compute Transformation*

The inlier pair from RANSAC will give the transformation between two images, we take the average displacement as our final transformation.

Blending

A simple linear blend is used. In order to reduce the area of the blurred region, we only perform linear blending from the middle of the overlapping region of the two images with 0.25 percent of the width.

- **Result**