International Journal of Contemporary Research in Computer Science and Technology (IJCRCST) ISSN: 2395-5325
Volume 3, Special Issue 3 (September '2017)
Proceeding of - International Conference on Recent Trends in Computational Life Science and Information Technology,
Conference held at Tiruppur Kumaran College for Women,Tirupur,Tamilnadu, India.

PANORAMIC IMAGE MATCHING BY COMBINING HARRIS WITH SIFT DESCRIPTOR

R. Subha Sree,
M. Phil Research Scholar,
Department of Computer Science,
Tirupur Kumaran College for Women,
Tirupur, Tamilnadu, India.

V. Malathi,
Assistant Professor,
Department of Computer Science,
Tirupur Kumaran College for Women,
Tirupur, Tamilnadu, India.

Abstract: We present a novel image stitching approach, which can produce visually plausible panoramic images with the input taken from different viewpoints. Unlike previous methods, our approach allows wide baselines between images and non-planar scene structures. Instead of 3D reconstruction, we design a mesh- based framework to optimize alignment and regularity in 2D. By solving a global objective function consisting of alignment and a set of prior constraints, we construct panoramic images, which are locally as perspective as possible and yet nearly orthogonal in the global view. We improve composition and achieve good performance on misaligned area. Experimental results on challenging data demonstrate the effectiveness of the proposed method. In proposed method that combined Harris with SIFT, using the Harris algorithm with adaptive threshold to extract the corners and the SIFT descriptor to make the registration, which generated a 360-degree panoramic image quickly. And there are many panoramic image mosaic software, such as Photo Stitch, Panorama Maker, PixMaker and so on. The key of constructing a measurable aerial panorama is obtain the position and poseur of the aerial panoramic image. Although these software are easy for us to generate panoramic image, the geographical location information of the image can't be obtained, and the problem leads the aerial panoramic image can't be measured and located. The algorithm of panoramic images and multi-view oblique images stitching is needed so that we can get the relation between them, which helps us locate the position of panoramic images.

Keywords – Panoramic Image, Image Processing, SIFT, Harris

I. INTRODUCTION

With the prevalence of smart phones, sharing photos has become popular. Since cameras generally have a limited field of view, panoramic shooting mode is provided, where the usercan capture images under guidance to generate a panorama. Panoramic stitching from a single viewpoint has been maturely studied. It is difficult however to generate reasonable results from a set of images under wide baselines. To produce a large field-of-view image for a close object, the camera needs to be shifted to capture various regions, which causes trouble for general panorama construction. Images captured from multiple cameras raise similar challenges. All such applications require panorama techniques considering no ignorable baselines among different cameras.

With the development of surveying and mapping technology and the requirement of society, the 360-degree panoramic image has been applied in many community services. However, the panoramic images mainly act as the role of virtual sense, and the panoramic image software only provides some simple functions, such as roam and query. In recent years, the UAVs surveying method is widely applied in large scale aerial surveying and the emergency of surveying and mapping. It plays an important role in disaster prevention and emergency response. If the high frequently of the geological and natural disasters happen, it can quickly and accurately access the disaster areas of high spatial resolution image. Nowadays, the images based on LBS (local based service) are more widely chased by people. The measurable aerial panorama is a technology that combines the panoramic images with the method of UAVs surveying and LBS, which can be used in many cases of our daily life.

Panoramic image mosaic is a technology to match a series of images which are overlapped with each other. Gao Bo proposed a method that combined Harris with SIFT, using the Harris algorithm with adaptive threshold to extract the corners and the SIFT descriptor to make the registration, which generated a 360degree panoramic image quickly. And there are many panoramic image mosaic software, such as Photo Stitch, Panorama Maker, PixMaker and so on. The key of constructing a measurable aerial panorama is obtain the position and poseur of the aerial panoramic image. Although these software are easy for us to generate panoramic image, the geographical location information of the image can't be obtained, and the problem leads the aerial panoramic image can't be measured and located. The algorithm of panoramic images and multi-view oblique images stitching is needed so that we can get the relation between them, which helps us locate the position of panoramic images.

Because panoramic image has large distortion, the difficulty of matching it with multi-view oblique images increases. In recent years, some algorithms about panoramic image stitching are provided. Wang Kai-yu, Xia gui-hua, and Zhu Qi-dan proposed an improved panoramic image feature extraction and matching algorithm base on SURF and improved KD tree search, SURF was used to extract feature point and generate feature description, the KD tree search method with high efficiency was used to match feature point Roland Glantz, Marcello Pelillo and Walter G. Kropatsch matched hierarchies from panoramic images by constructing an association graph whose vertices represented potential matches and whose edges indicated topological consistency.

A. Objective of The Project

Images are an integral part of our daily lives. Image stitching is the process performed to generate one panoramic image from a series of smaller, overlapping images. Stitched images are used in applications such as interactive panoramic viewing of images, architectural walk-through, multi-node movies and other applications associated with modeling the 3D environment using images acquired from the real world. By solving a global objective function consisting of alignment and a set of prior constraints, we construct panoramic images, which are locally as perspective as possible and yet nearly orthogonal in the global view. We improve composition and achieve good performance on misaligned area. In proposed method that combined Harris with SIFT, using the Harris algorithm with adaptive threshold to extract the corners and the SIFT descriptor to make the registration, which generated a 360-degree panoramic image quickly. And there are many panoramic image mosaic software, such as Photo Stitch, Panorama Maker, PixMaker and so on.

B. Motivation

In this project we aimed to implement a now popular feature in modern day cameras, panorama image stitching (also known as image mosaicing). Usually when this is done on a camera, either several pictures are taken manually which are then stitched together or the view is panned through a scene while the camera automatically takes images which will then be stitched together. For this project we implemented a version of panorama image stitching where the program searches through a folder of images (for example, a folder of summer vacation photos), and determines if there are appropriate matches for some of the images. If there exist panoramas in the folder, the program outputs all possible panoramas that can be validly stitched together. While stitching together two images known to overlap is a relatively simple problem (with one challenge being dynamically matching points in multiple images), the task of mosaicing multiple images and the problem of determining which images depict overlapping scenes from a folder of images taken at many different times and places is a much more complex challenge. This essentially requires extracting and matching key points from each image and every other image in the folder (because any 2 images could overlap at any point in the scene), and only constructing panoramas for image matches with valid homographies. Another challenge is to smooth the discontinuities of image boundaries, a task known as image splining.

C. Problem Definition

A parallax-tolerant image stitching method is built upon an observation that aligning images perfectly over the whole overlapping area is not necessary for image stitching. Instead, we only need to align them in such a way that there exists a local region in the overlapping area where these images can be stitched together. We call this local stitching and develop an efficient method to and such a local alignment that allows for optimal stitching. Our local stitching method adopts a hybrid alignment model that uses both homography and content-preserving warping. Homography can pre-serve global image structures but cannot handle parallax. In contrast, content-preserving warping can better handle parallax than homography, but cannot preserve global image structures as well as homography. Moreover, local stitching still prefers a well aligned, large local common region. However, when homography is used to align images with large parallax, the local region size and alignment quality are often two conflicting goals. We address this problem by using homography to only roughly align images and employing content-preserving warping to refine the alignment.

II. LITERATURE REVIEW

A. Automatic Panoramic Image Stitching using Invariant Features

Panoramic image stitching has an extensive research literature [Sze04, Mil75, BL03] and several commercial applications [Che95, REA, MSF]. The basic geometry of the problem is well understood, and consists of estimating a 3 × 3 camera matrix or homography for each image [HZ04, SS97]. This estimation process needs an initialization, which is typically provided by user input to approximately align the images, or a fixed image ordering. For example, the Photo Stitch software bundled with Canon digital cameras requires a horizontal or vertical sweep, or a square matrix of images. REALVIZ Stitcher version 4 [REA] has a user interface to roughly position the images with a mouse, before automatic registration proceeds. Our work is novel in that we require no such initialization to be provided.

This paper describes an invariant feature based approach to fully automatic panoramic image stitching. This has several advantages over previous approaches. Firstly, our use of invariant features enables reliable matching of panoramic image sequences despite rotation, zoom and illumination change in the input images. Secondly, by viewing image stitching as a multi-image matching problem, we can automatically discover the matching relationships between the images, and recognize panoramas in unordered datasets. Thirdly, we generate high-quality results using multi-band blending to render seamless output panoramas. This paper extends our earlier work in the area [BL03] by introducing gain compensation and automatic straightening steps. We also describe an efficient bundle adjustment implementation and show how to perform multi-band blending for multiple overlapping images with any number of bands.

B. Image Registration with Global and Local Luminance Alignment

Creating panoramas or mosaics is still an inexpensive and commonly adopted method to generate photographs of higher resolution and/or of wider angle of view. To successfully generate a visually acceptable or seamless mosaic from a few images, many registration methods have been proposed, which align images taken under a subclass of camera motions. However, in the registration process, the

environment illuminance (or brightness) recorded by a moving/rotating camera is often inconsistent even for a static scene. Exposure variation and other camera internal parameters further complicate the light recording process, causing abrupt color transition from one image to another. Seams in the image composite are quite noticeable. Worst, these complications may lead to image misregistration. Image mosaics with large exposure difference results in unnatural color transition and misregistration.
Estimating response function is an under-constrained problem. One common approach to tackle the problem is to perform radiometric calibration, by taking several images of a static scene under different lighting conditions. The consistency requirement of conditions other than exposures is crucial to the stability of the resulting model. This is difficult especially when image noise and ambiguities are very common. Moreover, even if such a model can be reliably estimated, the evaluation metric may not be available to judge the efficiency or optimality of the obtained model.

C. Multi-Image Matching using Multi-Scale Oriented Patches

Early work in image matching fell into two camps – direct and feature-based. Feature-based methods attempt to extract salient features such as edges and corners and use a small amount of local information e.g. correlation of a small image patch, to establish matches. Direct methods attempt to use all of the pixel values in order to iteratively align images. Invariant feature-based approaches to matching have been successfully applied to a wide range of problems, including object recognition, structure from motion, and panoramic image stitching. In this paper, we concentrate on the latter application, where we expect the amount of foreshortening and scale variation to be fairly small.

D. QuickTime VR – An Image-Based Approach to Virtual Environment Navigation

A key component in most virtual reality systems is the ability to perform a walkthrough of a virtual environment from different viewing positions and orientations. The walkthrough requires the synthesis of the virtual environment and the simulation of a virtual camera moving in the environment with up to six degrees of freedom. The synthesis and navigation are usually accomplished with one of the following two methods.

1) 3D Modeling and Rendering:

Traditionally, a virtual environment is synthesized as a collection of 3D geometrical entities. The geometrical entities are rendered in real-time, often with the help of special purpose 3D rendering engines, to provide an interactive walkthrough experience. The 3D modeling and rendering approach has three main problems. First, creating the geometrical entities is a laborious manual process. Second, because the walkthrough needs to be performed in real-time, the rendering engine usually places a limit on scene complexity and rendering quality. Third, the need for a special purpose rendering engine has limited the availability of virtual reality for most people since the necessary hardware is not widely available.

2) Branching Movies:

Another approach to synthesize and navigate in virtual environments, which has been used extensively in the video game industry, is branching movies. Multiple movie segments depicting spatial navigation paths are connected together at selected branch points. The user is allowed to move on to a different path only at these branching points. This approach usually uses photography or computer rendering to create the movies. A computer-driven analog or digital video player is used for interactive playback.

E. Distinctive Image Features from Scale-Invariant Key points

Image matching is a fundamental aspect of many problems in computer vision, including object or scene recognition, solving for 3D structure from multiple images, stereo correspondence, and motion tracking. This paper describes image features that have many properties that make them suitable for matching differing images of an object or scene. The features are invariant to image scaling and rotation, and partially invariant to change in illumination and 3D camera viewpoint. They are well localized in both the spatial and frequency domains, reducing the probability of disruption by occlusion, clutter, or noise. Large numbers of features can be extracted from typical images with efficient algorithms. In addition, the features are highly distinctive, which allows a single feature to be correctly matched with high probability against a large database of features, providing a basis for object and scene recognition. The cost of extracting these features is minimized by taking a cascade filtering approach, in which the more expensive operations are applied only at locations that pass an initial test.

F. Handling Occlusions in Dense Multi-view Stereo

One of the classic research problems in computer vision is that of stereo, i.e., the reconstruction of three-dimensional shape from two or more intensity images. Such reconstruction has many practical applications; including robot navigation, object recognition, and more recently, realistic scene visualization (image-based rendering). Why is stereo so difficult? Even if we disregard non-rigid effects such as specularities, reflections, and transparencies, a complete and general solution to stereo has yet to be found. This can be attributed to depth discontinuities, which cause occlusions and disocclusions, and to lack of texture in images. Depth discontinuities cause objects to appear and disappear at different viewpoints, thus confounding the matching process at or near object boundaries. The lack of texture, meanwhile, results in ambiguities in depth assignments caused by the presence of multiple good matches.

III. SYSTEM ANALYSIS

A. Existing System

A parallax-tolerant image stitching method is used in the existing system. Our method is built upon an observation that aligning images perfectly over the whole overlapping area is not necessary for image stitching. Instead, we only need to align them in such a way that there exists a local region in the overlapping area where these images can be stitched together. We call this local stitching and develop an efficient method to and such a local alignment that allows for optimal stitching. Our local stitching method adopts a hybrid alignment model that uses both homography and content-preserving warping. Homography can pre-serve global image structures but cannot handle parallax. In contrast, content-preserving warping can better handle parallax than homography, but cannot preserve global image structures as well as homography. Moreover, local stitching still prefers a well aligned, large local common region. However, when homography is used to align images with large parallax, the local region size and alignment quality are often two conflicting goals. We address this problem by using homography to only roughly align images and employing content-preserving warping to refine the alignment.

Drawbacks of existing system:

- This method still faces challenges in handling wide-baseline images.
- This method selects one image as the reference, and warps other images to it, which may cause large perspective distortion when photographing a long scene.
- Existing system does not compare with other images.

B. Proposed System

In the proposed system, Harris is combined with SIFT. This is combined using Harris algorithm with adaptive threshold to extract the corners and the SIFT descriptor to make the registration. It generates 360 degree panorama image quickly. The algorithm of panoramic images and multi-view oblique images stitching is needed so that we can get the relation between them which helps us to locate the position of panoramic images. The main steps contain projection, matching and back projection. The method starts from generating the image by projecting the aerial panoramic image according to the degree. Then a set of seed points are exacted by matching between the projected image and the corresponding multi-view images. Finally, the seed points in the projected image back projection on the aerial panoramic image. Experiments demonstrate the accuracy of our approach, and the result is satisfactory.

Advantages of proposed system:

- The proposed method helps to generate 360 degree panorama view quickly.
- Harris algorithm is used to generate panoramic image easily.
- Comparison is made with all the images so we can get the relationship between the images.
- Accuracy of the measurable aerial panorama is determined.
- The method starts from generating the image by projecting the aerial panoramic image according to the degree.

IV. SYSTEM DESIGN

A. ***System Architecture***

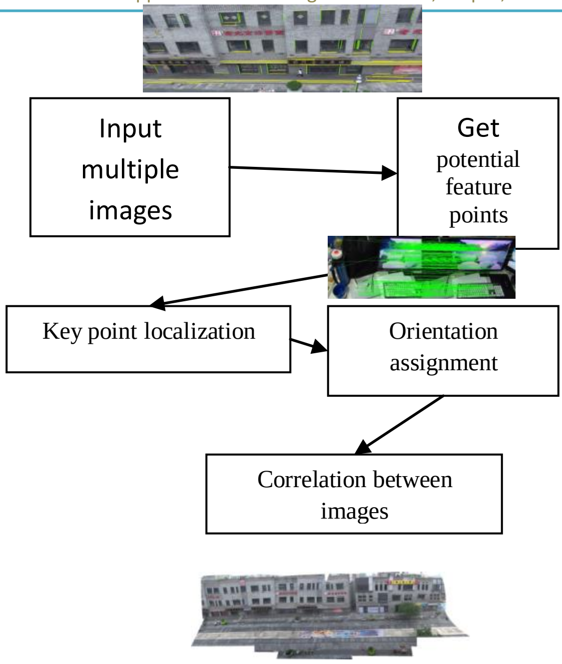


Figure1: Architecture Diagram

V. SYSTEM IMPLEMENTATION

A. Module Description

- Scale-space peak selection
- Key point localization
- Orientation assignment
- Key point descriptor
- Regularization
- Scale Preservation

1) Scale-space peak selection:

In the first stage, potential feature points are searched over all scales and image locations. This is implemented efficiently by using a series of difference-of-Gaussian (DoG) images to identify local peaks (termed key points) that are invariant to scale and orientation.

2) Key point localization:

At each candidate location, a three dimensional quadratic function model is fit to determine location (sub-pixel accuracy) and scale. Key points are discarded if found to be unstable.

A feature point p inside the grid whose four vertices are denoted as v1, v2, v3, and v4. The interpolation weights are computed as:

w1 = (v3x * px)(v3y *py);
w2 = (px * v4x)(v4y *py);
w3 = (px * v1x)(v1y *py);
w4 = (px * v2x)(v2y *py);

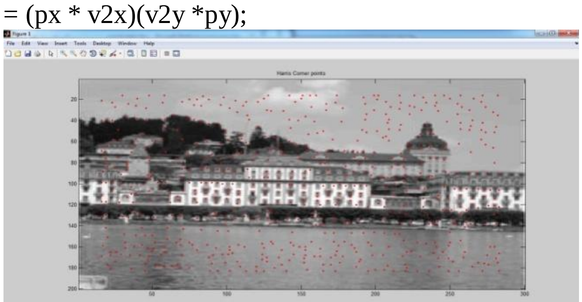


Figure2: Key Point Localization

3) Orientation assignment:

One or more dominant orientations for each key point are assigned based on its local image gradient directions. The assigned location, orientation(s) and scale for each key point enables SIFT to construct a canonical view for the key point, there by providing invariance to similarity transformations.

4) Key point descriptor:

This stage builds a local image descriptor for each key point, based on the image gradients in the region of selected scale around the key point. After the matching process and when each homonym my points are found out, the correlation between left image and right one can be determined, and the seed points in both images are saved. Some homonymy points in the right projected image and the left corresponding multi-view oblique image.

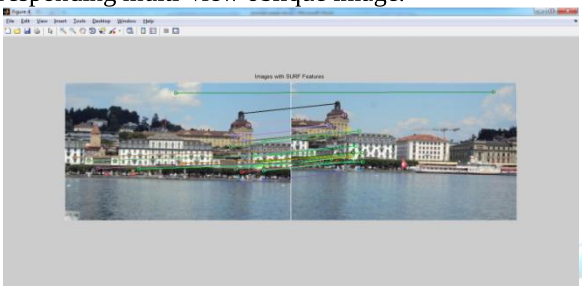


Figure3: Key point descriptor

5) Regularization

The alignment term only affects grids with feature points. We need a regularization term to propagate transformation to other regions. A similarity term is used to preserve the shape for each mesh grid. It however does not work well in our cases. For panoramic stitching, it is not reasonable to enforce similarity constraints, since perspective correction is generally necessary. With the local planar assumption, we prefer meshes that warp local neighboring regions with similar homo graphics.

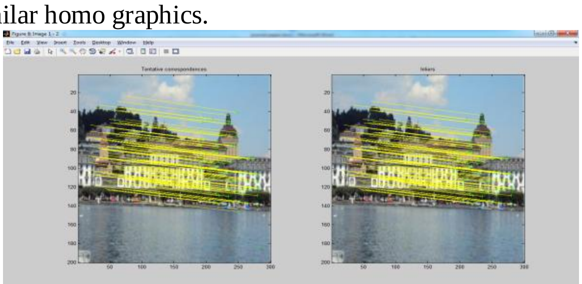
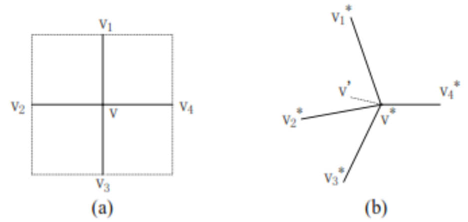


Figure4: Regularization

For each vertex v, we estimate a local homography *H* with its four neighbors v1, v2, v3, v4 and their warped positions v_1^*, v_2^*, v_3^*, v_4^*. Then we apply H on the vertex v to get the regular position v′. We minimize the Euclidean distance between v′ and real position v^*.

our regularization term is defined as

$$E_R(V) = \sum_{v} \|W_v V - \frac{1}{|N_v|} \sum_{v_i \in N_v} W_{v_i} V\|^2,$$



Regularization Term (a) Original vertices (b) Warped vertices

6) Scale Preservation

The alignment and regularization terms actually form a linear system as AV = 0, where V = 0 always satisfies this linear system. In order to avoid this degeneration problem, methods were proposed to select one image as the reference view. This strategy works if there are only a few images. With the increasing field-of view, images far from the reference one may be significantly distorted in order to reduce the alignment error. The right-most images are obviously scaled down. To address this problem, the scale constraint should be applied to all images equally. The scale of an image can be measured by its four edges, since the inner area can be interpolated once the edge scales are decided. We estimate a scaling factor for each image according to the feature points.

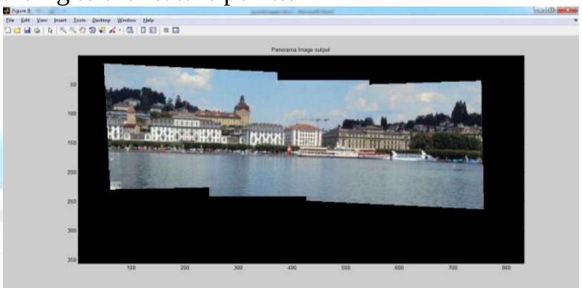


Figure5: Panorama Output

With the scaling factors, we add a constraint for each image. For scale preserving term is defined as

$$E_S(V) = \sum_{I_i \in I} |S(I_i^*) - s_i S(I_i)|^2,$$

$$S(I_i) = \begin{bmatrix} \|B_t\| + \|B_b\| \\ \|B_l\| + \|B_r\| \end{bmatrix},$$

where I_i^* and I_i are the i-th warped and original images respectively. S is a scale measurement for images defined as a 2D vector. B_t, B_b , B_l and B_r are the top, bottom, left andright edges of image I_i and can be represented with vertices V .

VI. CONCLUSION

In this paper, we propose a method of aerial panoramic image and multi-view oblique image matching for constructing a measurable panorama. The proposed stratagem matches multi-view oblique images with images generated by projecting aerial panoramic images according to the degree. And this stratagem solves the problem that the strong distortion of panoramic image can't be directly matched with oblique images. The accuracy of our method is estimated by the space resection of sphere model, and the experiment result demonstrates that our method can meet the needs in measurable aerial panorama. The main work in the future will be projecting the cloud points or DSM (Digital Surface Model), which is generated by dense match algorithm, to the panoramic sphere, and then, each pixel points of aerial panoramic image can obtain the corresponding geodetic coordinates.

A) Future Enhancements

There are several ways we can improve our results. A simple approach we are beginning to explore would allow us to handle shifts in the depth of the dominant plane. Already it has been shown that geometry at the dominant plane is aligned between the projected source images. If the picture surface is parallel to the camera path, however, a horizontal translation of the projected source images along the picture surface can be used to align geometry at any plane parallel to the dominant plane (this observation is true for the same reasons that a horizontal disparity can explain variations in depth for a stereo pair of images). Such translations could be used to stabilize geometry in a scene where the dominant plane shifts.

VII. REFERENCES

[1] M. Brown and D. Lowe. Automatic panoramic image stitching using invariant features. International Journal of Computer Vision, 74(1):59–73, 2007.

[2] J. Jia and C.-K. Tang. Image registration with global and local luminance alignment. In ICCV, 2003.

[3] M. Brown, R. Szeliski, and S. Winder. Multiimage matching using multi-scale oriented patches. In *Proceedings of the Interational Conference on Computer Vision and Pattern Recognition (CVPR05)*, San Diego, June 2005.

[4] S. Chen. QuickTime VR – An image-based approach to virtual environment navigation.

[5] LOWE, D. 2004. Distinctive image features from scale-invariant key points. *International Journal of Computer Vision 60*, 2, 91–110.

[6] KANG,S.B.,SZELISKI,R.,AND CHAI, J. 2001. Handling occlusions in dense multi-view stereo. In *Computer Vision and Pattern Recognition (CVPR 2001)*, vol. 1, 103–110.

[7] R. Szeliski. Image alignment and stitching: A tutorial. Technical Report MSR-TR-2004-92, Microsoft Research, December 2004.

[8] BOYKOV,Y.,VEKSLER,O.,AND ZABIH, R. 2001. Fast approximate energy minimization via graph cuts. *IEEE Transactions on Pattern Analysis and Machine Intelligence 23*, 11, 1222–1239.

[9] YU,J.,AND MCMILLAN, L. 2004. A framework for multiper- spective rendering. In *Proceedings of the 15th Euro graphics workshop on rendering Techniques*, 61–68.

[10] YU,J.,AND MCMILLAN, L. 2004. General linear cameras. In *European Conference on Computer Vision (ECCV 04)*, 14–27.

[11] ZHENG, J. Y. 2003. Digital route panoramas. *IEEE Multimedia 10*, 3, 57–67.

[12] ZOMET, A.,FELDMAN,D.,PELEG,S.,AND WEINSHALL,D. 2003. Mosaicing new views: The crossed-slits projection. *IEEE Transactions on PAMI 25*, 6, 741–754.