

Efficient Panorama Image Stitching with Wide Angle Images

M. Sivaraman¹, C. Rajeshkannan²

M.E. Computer Science and Engineering, Mount Zion College of Engineering and Technology, Lena Vilakku, Thirumayam Tk, Pudukkottai, Tamil Nadu 622507, India.

Assistant Professor, Department of Computer Science and Engineering, Mount Zion College of Engineering and Technology, Lena Vilakku, Thirumayam Tk, Pudukkottai, Tamil Nadu 622507, India.

ABSTRACT: The main objective of this system is to provide an efficient methodology to Panoramic stitching to a single viewpoint from a set of images under wide baselines using SIFT combined with SURF features algorithm. This approach allows wide baselines between images and non-planar scene structures. Instead of 3D reconstruction, we can design a mesh based framework to optimize alignment and regularity in 2D. Improve composition and achieve good performance on misaligned area. We present a novel image stitching approach, which can produce visually input panoramic images taken from different viewpoints. In previous methods, our approach allows wide baselines between images and non-planar scene structures. Instead of 3D reconstruction, we design a mesh base framework to optimize alignment and regularity in 2D. To solve a global objective function consisting of alignment and a set of prior constraints, we construct panoramic images, which is 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.

KEYWORDS: Image Stitching, Multi-View Panorama, Image Alignment, Wide-Baseline Images.

I. INTRODUCTION

The main Objectives of this system are as follows:

- To produce a large field-of-view image for a close object, the camera needs to be shifted to capture various regions, which cause trouble for general panorama construction.
- Images captured from multiple cameras raise similar challenges.
- Many previous image stitching methods require simple camera rotation or planar scene.
- Violation of these assumptions may lead to severe problems.

With the prevalence of smart phones, sharing photos has become popular. Since cameras generally have a limited field of view, panoramic shooting mode is provide, where the user can 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 nonignorable baselines among different cameras. Many previous image stitching methods require simple camera rotation, or planar scene. Violation of these assumptions may lead to severe problems. Recent methods relaxed these constraints by dual-homography, or smoothly varying affine/homography. They work for images with moderate parallax, but are still problematic in the wide-baseline condition, as demonstrated. In this paper, we propose a stitching approach for widebaseline images. Our main contribution is a mesh-based framework combining terms to optimize image alignment.

International Journal of Innovative Research in Science, Engineering and Technology

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Website: www.ijirset.com

Vol. 6, Issue 2, February 2017

A novel scale preserving term is introduced to make alignment nearly parallel to image plane but still allow local perspective correction. A new seam-cut model reduces visual artifacts caused by misalignment that is difficult to handle by traditional seam-cutting algorithms. Figure 1 shows a challenging urban scene example where 14 images are captured in different positions. Our generated panorama is visually compelling.

II. 3D RECONSTRUCTION

Given the dense depth maps of a scene, the panoramic view can be generated by 3D modeling with texture mapping. However, multi-view stereo techniques are constrained by a series of conditions including camera motion and Lambertian surface assumption. It is difficult to produce perfect 3D models in many cases, especially when there are only a few images. In the application of video stabilization where the baseline between source and target images is small, the reconstructed sparse 3D points may be enough for content-preserving warp [15], [16]. But this does not work that well for wide-baseline images with complex structure. Agarwala constructed multi-viewpoint panoramas for approximately planar scenes. Structure-from-motion was used to recover camera poses and sparse 3D points. Then a dominant plane was selected manually so that the input images can be projected for stitching. In contrast, our method is an automatic approach without recovery of camera motion and 3D structures.

Mesh Optimization and Panoramic Mosaics

Mesh optimization and manipulation perform well on image retargeting, resizing, rectangling, and video stabilization. These methods use different global energy functions depending on their targets, and solve for the optimal mesh configuration.

A similarity constraint was usually used for regularization, which however is not appropriate for perspective projection. For instance, parallel lines are not parallel under perspective transformation. Differently, our proposed straightness constraint does not involve the parallelism constraint and is more appropriate for perspective transformation. Panoramic image techniques work best for camera that undergoes only rotation. For other types of camera motion, misalignment artifacts could be introduced. Although seam optimization and gradient domain fusion techniques can be used, they do not solve the problem by nature. Recently, Gao proposed a dual-homography model to align overlapping images, where warping can be modeled as linear interpolation of two homographies.

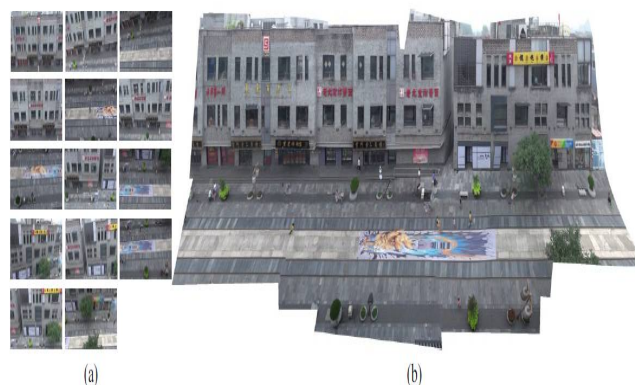


Fig. 1: Automatically constructed urban panorama with 14 wide-baseline images. (a) Input images. (b) The reconstructed panorama.

Seamless Composition and Feature Matching

Graph cuts stitch images by optimizing a Markov random field (MRF). Agarwala proposed incorporating 3D information, while several other methods used a binary function depending on the visibility of pixels. The smoothness term penalizes color differences on the seams. In our widebaseline cases, misaligned pixels may coincidentally have

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 2, February 2017

similar colors, which makes it difficult to detect bad seams via color. In order to address this problem, we combine alignment errors and colors in a new way. Like most previous approaches, we use SIFT to find correspondences. For challenging data, ASIFT is adopted to obtain more feature matches. Estimating epipolar geometry with RANSAC can reject mismatched correspondences.



Fig. 2: Outliers rejection comparison. (a) Matched features by SIFT. (b) Recognized inliers by RANSAC with global homography. (c) Recognized inliers by our approach.

Feature Alignment

We represent each feature point as a weighted sum of their four enclosing control vertices, and minimize alignment errors of the warped points over all features. Similar to earlier approaches, we use bilinear interpolation to calculate weights on the original meshes, which is equivalent to the barycenter representation.

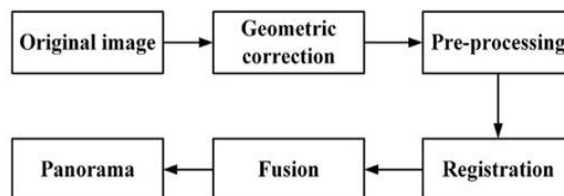


Fig.3. System Architecture Design

As illustrated in Figure 4, there is a feature point p inside the grid whose four vertices are denoted as v_1 , v_2 , v_3 , and v_4 . The interpolation weights are computed as:

$$w_1 = (v_3x * px)(v_3y * py);$$

$$w_2 = (px * v_4x)(v_4y * py);$$

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(An ISO 3297: 2007 Certified Organization)

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$$w3 = (px * v1x)(py * v1y);$$
$$w4 = (v2x * px)(py * v2y);$$

We assume that the interpolation weights are fixed after warping the grids (i.e., assuming affine transformation for each grid). As demonstrated in our supplementary document1, this assumption is reasonable in a typical panorama scenario especially when the mesh grid size is small. So we define the alignment term as a set containing feature correspondences of all image pairs. p_i and q_i are warped positions of the two matched points, whose coordinates are weighted sums of the mesh vertices in V .

III. EXISTING SYSTEM

SIFT Features Analysing Methodology

With this algorithm it is difficult to stitching more than one image into a single view for users, 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 non-ignorable baselines among different cameras. So a new methodology is required to resolve all the mentioned problems in past.

IV. PROPOSED METHODOLOGY

Proposed Methodology: SIFT combined with SURF features.

Extracting the features of scale and alignment variation contents of the with certain searching range.

This feature extraction includes the feature alignment, scale preservation, line preservation

To improve the performance of matching the baseline alignment, we combine the SURF with SIFT and make the alignment correction for linear and orientation alignment are preserved.

The multi-Homography model to support the discontinuity representation around occlusion boundaries, which may require accurate segmentation.

V. LITERATURE SURVEY

This system presents a novel approach to creating full view panoramic mosaics from image sequences. Unlike current panoramic stitching methods, which usually require pure horizontal camera panning, our system does not require any controlled motions or constraints on how the images are taken (as long as there is no strong motion parallax). For example, images taken from a hand-held digital camera can be stitched seamlessly into panoramic mosaics.

Because we represent our image mosaics using a set of transforms, there are no singularity problems such as those existing at the top and bottom of cylindrical or spherical maps. Our algorithm is fast and robust because it directly recovers 3D rotations instead of general 8 parameter planar perspective transforms. Methods to recover camera focal length are also presented. We also present an algorithm for efficiently extracting environment maps from our image mosaics.

We present a system for producing multi-viewpoint panoramas of long, roughly planar scenes, such as the facades of buildings along a city street, from a relatively sparse set of photographs captured with a handheld still camera that is moved along the scene.

Our work is a significant departure from previous methods for creating multi-viewpoint panoramas, which composite thin vertical strips from a video sequence captured by a translating video camera, in that the resulting panoramas are composed of relatively large regions of ordinary perspective. In our system, the only user input required beyond capturing the photographs themselves is to identify the dominant plane of the photographed scene; our system then computes a panorama automatically using Markov Random Field optimization. Users may exert additional control

International Journal of Innovative Research in Science, Engineering and Technology

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over the appearance of the result by drawing rough strokes that indicate various high-level goals. We demonstrate the results of our system on several scenes, including urban streets, a river bank, and a grocery store aisle.

This system proposes a content-aware image resizing method which simultaneously preserves both salient image features and important line structure properties: parallelism, collinearity and orientation. When there are prominent line structures in the image, image resizing methods without explicitly taking these properties into account could produce line structure distortions in their results.

Since the human visual system is very sensitive to line structures, such distortions often become noticeable and disturbing. Our method couples mesh deformations for image resizing with similarity transforms for line features. Mesh deformations are used to control content preservation while similarity transforms are analyzed in the Hough space to maintain line structure properties. Our method strikes a good balance between preserving content and maintaining line structure properties. Experiments show the proposed method often outperforms methods without taking line structures into account, especially for scenes with prominent line structures.

VII. EXPERIMENTAL RESULTS

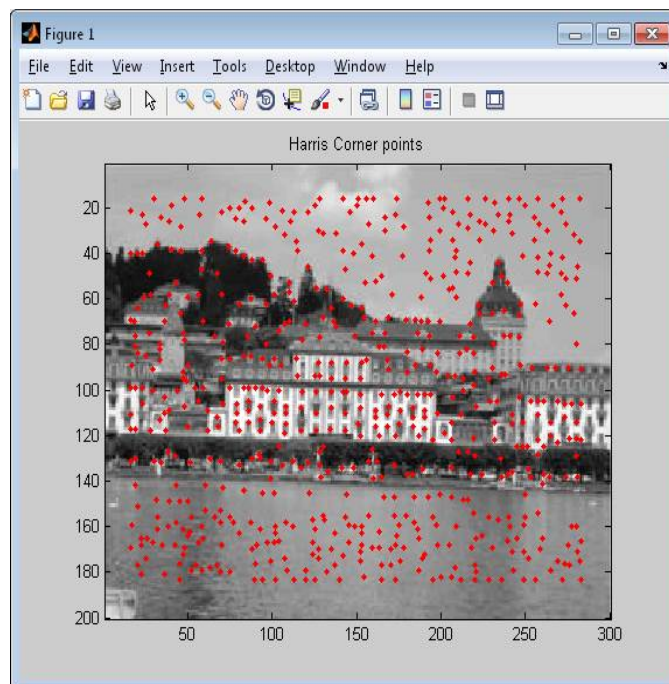


Fig.4 Harris Corner Points – 1st Input Image

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 2, February 2017

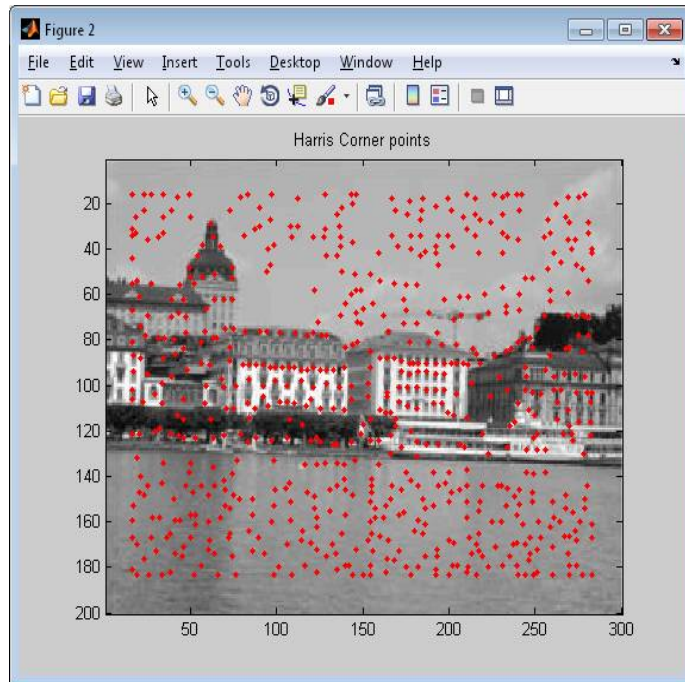


Fig.5 Harris Corner Points – 2nd Input Image

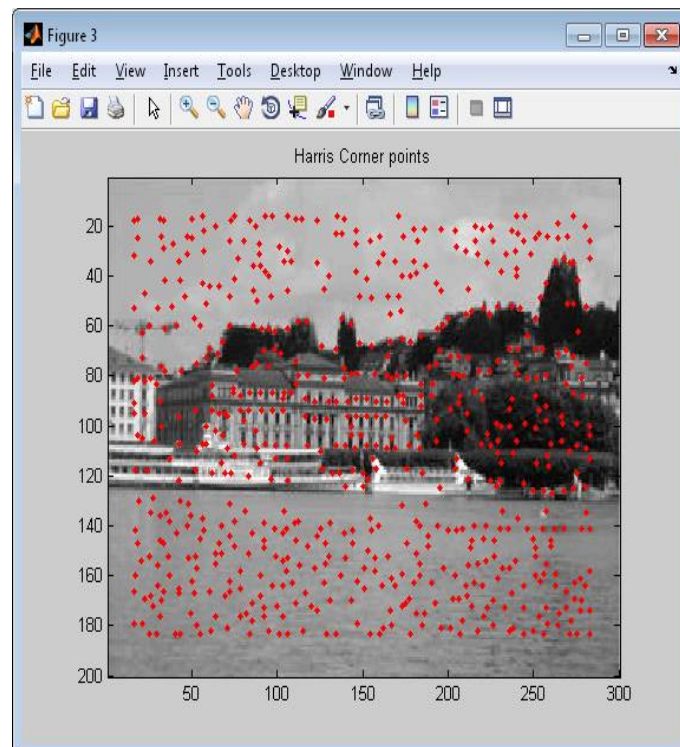


Fig.6 Harris Corner Points – 3rd Input Image

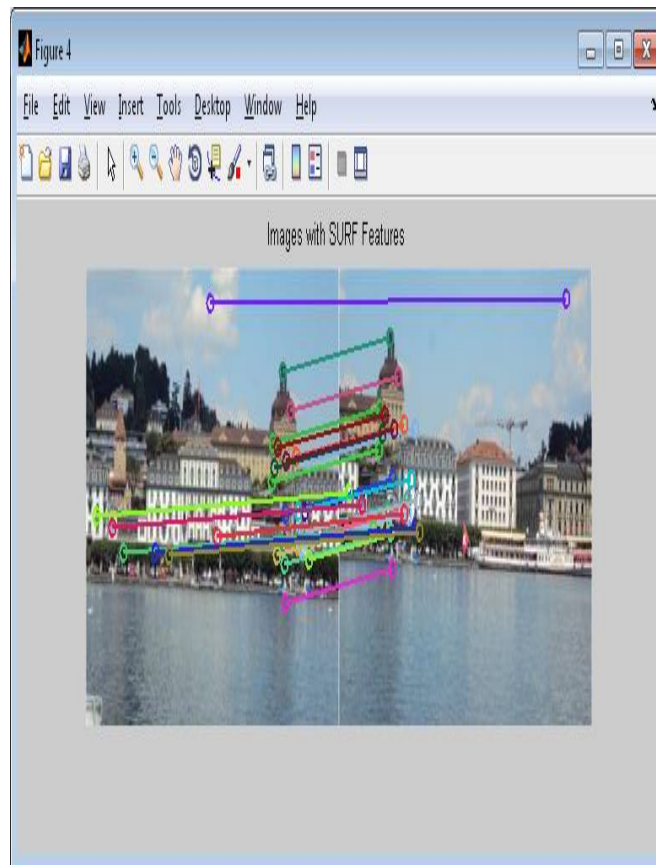


Fig.7 Image SURF Features

VIII. CONCLUSION AND FUTURE SCOPE

We have presented a new image stitching approach for wide-baseline images. With the flexibility of a mesh-based model, our method can accommodate moderate deviation from the planar structures. By combining feature alignment, regularization, scale preservation and other extra constraints, a reasonable quality multi-viewpoint panorama is accomplished without explicit 3D reconstruction. Our approach still has limitations. If a straight line spans across multiple images, our method can only preserve the local straightness in each image. This problem can be addressed either by performing line matching or manually specifying feature match along the lines if the corresponding matches are not automatically found. In addition, if the input images are with significant occlusion – one region appears in one image but is occluded in others – the occluded parts may not be aligned correctly, such as the highlighted red circle region in Figure 11(d). This problem can be alleviated with user interaction and seam cut. Our future work will be using the multi-homography model to support the discontinuity representation around occlusion boundaries, which may require accurate segmentation.

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BIOGRAPHY



Mr. Sivaraman. M. Studying M.E. Computer Science and Engineering in Mount Zion College of Engineering and Technology, which is located in Lena Vilakku, Pudukkottai, TamilNadu, India.