Optimization and Alignment of Multiple Images to Construct a Panoramic Images

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Images Captured From Multiple Cameras Raise Similar Challenges. All Such Applications Require Panorama Techniques Considering Non-Ignorable 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 Or Homography. They Work For Images With Moderate Parallax, But Are Still Problematic In The Wide-Baseline Condition. In This Project, We Propose A Stitching Approach For Wide Baseline Images. Our Main Contribution Is A Mesh-Based Framework Combining Terms To Optimize Image Alignment. 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 Be Handled By Traditional Seam-Cutting Algorithms.

I. Introduction


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. 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 Or Homography. They Work For Images With Moderate Parallax, But Are Still Problematic In The Wide-Baseline Condition. In This Project, We Propose A Stitching Approach For Wide Baseline Images. Our Main Contribution Is A Mesh-Based Framework Combining Terms To Optimize Image Alignment. 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 Be Handled By Traditional Seam-Cutting Algorithms.

II. Literature Survey

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III. Design Styles

1.1 System Architecture

The System Architecture Is Shown Below.

Input Of A Project Is A Video Or A Group Of Images, Video Means From The Video We Will Adding A Significant Feature And Form This Group Of Images, So Once The Group Of Images Is Given To The Feature Extraction Module It Will Compute For Each Image Shift Feature. Once We After Compute A Shift Feature For Each Image There Will Be A Inlier Detection For Each Image Who Are All Is Neighbors That Will Be Directed In Inlier Detection Module, So Once The Neighbors Are Detected Alignment Will Be Happening In The Alignment Module Where In The Features Will Be Correlated With Each Other Based On An Energy Function And We Will Try To Optimize The Function That Will Be Done In Feature Alignment. Once The Alignment Is Happen At The Borders To Improve A Smooth Transition We Will Be Applying A Seam Carving Technique And Once After Applying Seam Carving Technique For Final Image Transition Is Done. Transition Is Mainly For Scalability. Once This Is Done We Will Get A Panoramic Image.

1.2 Sequence Diagram for Upload Review

Sequence Diagram Will Say If Use Does One Action How All The Classes Will Be Will Interact With Each Other That Is Documented In Sequence Diagram. So First Is A User On The Main Say Load Video, So Once We Load A Video From The Main, Frame Extraction Class Function Extract Significant Frames Will Be Called And This Will Be Giving The Frames. Only Certain Image Frames Are Significant Frame Images. Once A Frame Are Return, System Will Get Acknowledgement, Then Call Do Processafter Main Process To Call On The Feature Extraction Module, Extract Shift Points For Each Images It Will Give A Group Of Images And The Call Extract Shift Points So This Will Give For Each Image What Are The Shift Points, Once A Shift Points Are Return It Will Do Then Call To Panorama Utility Class Detect Inlier Will Compute For Each Image Who Are Inlier Image Than It Will Give A Inlier Set, Once A Inlier Set Is There, The Panoramautil Class Called Do Feature Alignment So That Inlier Set Images Done In Feature Alignment, So Feature Alignment Is Done In
Inlier Set. Once a feature alignment is done after this call the panorama util class, do carving on borders of the grid system will do a carving. So once the carved image is there system will do transformation on it to preserve the scale. Now the system call on the user. The acknowledgement will be returned. After this the user will call view panorama image. Main will call the get panorama image function in panorama util class. Panorama util class return the panorama image to the main. User will get the panorama image by main.

**1.3 Data Flow Diagram Of The System**

The input, output and the process flow in the system is given in this section.

**Level 0 Data Flow Diagram**
Panorama construction is the main process of the system.

![Level 0 Data Flow Diagram](image)

**Level 1 Data Flow Diagram**

The panorama construction process is split to sub process in this section.

![Level 1 Data Flow Diagram](image)

Break the panorama construction into sub process. The sub processes are:

A). Feature Detection: Detect the objectives in each image.

B). Inlier Computation: Finding the neighboring set for each pair of them.

C). Feature Alignment: Align the image to obtain the output image.

D). Seam Curving: It works only for borders.

Transformation: It works for the scalability.

E). Panorama Image: Due to these sub processes we can obtain the panoramic image.

**1.4 Shift Feature Extraction**

In last couple of chapters, we saw some corner detectors like Harris etc. They are rotation-invariant, which means, even if the image is rotated, we can find the same corners. It is obvious because corners remain corners in rotated image also. But what about scaling? A corner may not be a corner if the image is scaled. For example, check a simple image below. A corner in a small image within a small window is flat when it is zoomed in the same window. So Harris corner is not scale-invariant.
So, In 2004, D. Lowe, University Of British Columbia, Came Up With A New Algorithm, Scale Invariant Feature Transform (Sift) In His Paper, Distinctive Image Features From Scale-Invariant Keypoints, Which Extract Keypoints And Compute Its Descriptors. (This Paper Is Easy To Understand And Considered To Be Best Material Available On Sift. So This Explanation Is Just A Short Summary Of This Paper).

There Are Mainly Four Steps Involved In Sift Algorithm. We Will See Them One-By-One.

1. Scale-Space Extrema Detection

   From The Image Above, It Is Obvious That We Can’t Use The Same Window To Detect Keypoints With Different Scale. It Is Ok With Small Corner. But To Detect Larger Corners We Need Larger Windows. For This, Scale-Space Filtering Is Used. In It, Laplacian Of Gaussian Is Found For The Image With Various $\sigma$ Values. Log Acts As A Blob Detector Which Detects Blobs In Various Sizes Due To Change In $\sigma$. In Short, $\sigma$ Acts As A Scaling Parameter. For Eg, In The Above Image, Gaussian Kernel With Low $\sigma$ Gives High Value For Small Corner While Gaussian Kernel With High $\sigma$ Fits Well For Larger Corner. So, We Can Find The Local Maxima Across The Scale And Space Which Gives Us A List Of $(x, y, \sigma)$ Values Which Means There Is A Potential Keypoint At $(X, Y)$ At $\sigma$ Scale.

   But This Log Is A Little Costly, So Sift Algorithm Uses Difference Of Gaussians Which Is An Approximation Of Log. Difference Of Gaussian Is Obtained As The Difference Of Gaussian Blurring Of An Image With Two Different $\sigma$, Let It Be $\sigma$ And $k\sigma$. This Process Is Done For Different Octaves Of The Image In Gaussian Pyramid. It Is Represented In Below Image:

![Scale-Space Extrema Detection Diagram](image)

Once This Dog Are Found, Images Are Searched For Local Extrema Over Scale And Space. For Eg, One Pixel In An Image Is Compared With Its 8 Neighbors As Well As 9 Pixels In Next Scale And 9 Pixels In Previous Scales. If It Is A Local Extrema, It Is A Potential Keypoint. It Basically Means That Keypoint Is Best Represented In That Scale. It Is Shown In Below Image:

![Local Extrema Detection Diagram](image)

Regarding Different Parameters, The Paper Gives Some Empirical Data Which Can Be Summarized As, Number Of Octaves = 4, Number Of Scale Levels = 5, Initial $\sigma = 1.6, k = \sqrt{2}$ Etc As Optimal Values.

Panorama Construction Algorithm
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Fig 1.5:- Panorama Construction Step

**Step 1:** Every Flow Chart Should Have A Start State, Input Is Iset Group Of Images

**Step 2:** For Each Image In The Iset Compute Sift Points.

**Step 3:** After Finding The Sift Points For Each Image I In Iset.

**Step 4:** Calculate The Distance, If The Distance Between The Ith Image And Jth Image Is Less Than The R, Than They Are Inlier Where R Is The Distance.

**Step 5:** Once We Get All The Inliers In The Image Are Detected. From These Points Form The Feature Alignment, For Each Image In Inlier Set. If The Images Are Inlier Than Only Perform Feature Alignment.

**Step 6:** Once The Feature Alignment Is Over For Each Alignment, Next Do Seam Curving At Borders After Doing Seam Curving Do Transformation At The Edges. At The Edge Of The Image Transformation.

**Step 7:** Output Is The Panorama Image.

**Step 8:** Stop State.

**Iv Results And Discussions.**

The Following Snapshots Define The Results Or Outputs That We Will Get After Step By Step Execution Of All The Modules Of The System.

**Interpretation:**

Install The VL_Feat Toolbox, Because All The Sift Feature Extraction Utilities Are Available In This Tool And Without This Tool, The Code Will Not Work.

The GUI Of The Project Opens And Browse

Choose The Image Directory Where The Individual Images Are Available For Panorama Construction Process.
After the Image Directory is selected, press Construct Panorama Button.

The Constructed Panorama is displayed and the time taken to construct panorama is also displayed.

From the video, most significant frames are extracted and saved in Images folder, so that panoramic can be constructed for those images just like other images.
For Natural Scenery Panorama Is Constructed And Demonstrated By Choosing The Scenery Of Images Directory.

The Constructed Panorama For Natural Scenery Is Displayed.

IV. Conclusion

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 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. This Problem Can Be Alleviated With User Interaction And Seam Cut. Our Future Work Will Be Using The Multi-Homography Model.

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References


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