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Object Removal and Error Concealment Using Mean Shift Algorithm in Free Moving Camera Videos

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ABSTRACT

In this paper a new video in painting method which applies to both static or free-moving camera videos. The method can be used for object removal, error concealment, and background reconstruction applications. To limit the computational time, a frame is in painted by considering a small number of neighboring pictures which are grouped into a group of pictures (GoP). This is achieved by a region-based computation method which allows us to strengthen the spatial consistency of aligned frames. Then, from the stack of aligned frames, an energy function based on both spatial and temporal coherency terms is globally minimized. Experiments with several challenging video sequences show that the proposed method provides visually pleasing results for object removal, error concealment, and background reconstruction context.

Keywords: Object, Camera, In Painting, Homography, Video, Pixels.

1. Introduction

Video in painting refers to methods consisting in filling in missing areas in video sequences. The missing areas can be the result of the removal of one or more undesired objects in the scene. The major issue of video in painting methods is to fill in the missing part, also called hole, as faithfully as possible both in space and time. This can be achieved by extending still images in painting methods, either by considering spatio-temporal similarities between patches by taken into account the motion information or by ensuring global space-time consistency thanks to the global minimization of an energy function. These methods work quite well for videos captured by static cameras. However, they often fail with videos captured by free-moving cameras. One solution to deal with complex dynamic video sequences is to register frames and preferably those located near the frame to be in painted. The missing areas can then be filled in by using the most appropriate known pixels in the stack of aligned frames. In this kind of methods, the quality of the in painting result significantly depends on the alignment quality.

2. Literature Survey

Exemplar based video in painting proposes a technical review of exemplar based in painting approaches with a particular focus on greedy methods. Several comparative and illustrative experiments are provided to deeply explore and enlighten these methods, and to have a better understanding on the state-of-the-art improvements of these approaches. From this analysis three improvements over Criminisi et al. algorithm are then presented: 1) a tensor based data term for a better selection of pixel candidates to fill in, 2) a fast patch lookup strategy to ensure a better global coherence of the reconstruction, and 3) a fast anisotropic spatial blending algorithm that reduces typical block artifacts using tensor models. Video in painting of complex scene paper proposes an automatic video in painting algorithm which relies on the optimization of a global, patch-based functional. The algorithm is able to deal with a variety of challenging situations which naturally arise in video in painting, such as the correct reconstruction of dynamic textures, multiple moving objects and moving background. Furthermore, we achieve this in an order of magnitude less execution time with respect to the state-of-the-art. These also able to achieve good quality results on high definition videos. Video in painting under constrained camera motion provide a framework for in painting missing parts of a video sequence recorded with a moving or stationary camera is presented in this work. The region to be in painted is general: It may be still or moving, in the background or in the foreground, it may occlude one object and be occluded by some other object. The algorithm consists of a simple preprocessing stage and two steps of video in painting. In the preprocessing stage, first roughly segment each frame into foreground and background. In the first video in painting step, the reconstruct moving objects in the foreground that are "occluded" by the region to be in painted.

3. Existing Work

The existing system can be used the Exemplar based greedy algorithms. It uses two steps for processing the in painting. In first step, Priority is assigned to the each pixel in the images. In second step, the selection of the best matching pixel from the image is done. The Homography Based Registration Method can be used for the registration of frames in the video sequence. There are two widely used alignment approaches are used in the exemplar methods are namely the dense and sparse motion-based alignment. The dense approaches estimate the 2D or 3D motion vectors. The 2D methods compute the motion vectors between consecutive frames in the video. The 3D methods estimate the global camera motion by using all frames in the video. This generally provides more accurate results but at the expense of a higher computational cost. Sparse-based methods yield a fast and robust alignment. These algorithms use the Homography transformation which relates the pixel coordinates in the two images. A single Homography transformation is not sufficient to align a pair of images.

4. Proposed Frame Work

The proposed method is then drastically less complex than the most recent techniques. The proposed approach performs the in painting of the input video sequence using a sliding temporal group of frames. Frames Registration This section is devoted to the first step of the algorithm which consists in aligning the neighboring source frames Is with the target frame It . The proposed method aims at being well suited for various viewpoint changes and motion characteristics, while being fast enough to be reasonably considered as a preprocessing step in video editing algorithms. A region-based Homography which limits alignment errors and reduces the computational complexity. This is a key point since misalignment is the main source of temporal incoherence in the in painted result. A spatio- temporal in painting method based on a new well-defined cost function ensuring both spatial and temporal coherence. An efficient spatial in painting initialization is used for both guiding the choice of the most likely pixel value in the aligned neighboring frames and recovering static regions. In the Hole Filling, once the neighboring frames have been aligned, they form a stack of images from which the in painting of missing areas is performed. To get spatio-temporal consistency, missing areas of frame It are in painted by minimizing globally (for all pixels in _t) an energy function that expresses this consistency. First, SIFT features are extracted and clustered into two groups based on their spatial positions in the image. The mean-shift algorithm, which is a fast and automatic segmentation tool and the poisson image blending, is a popular tool for seamless image cloning. In this paper, the Poisson blending is used to provide high quality of the in painted result.

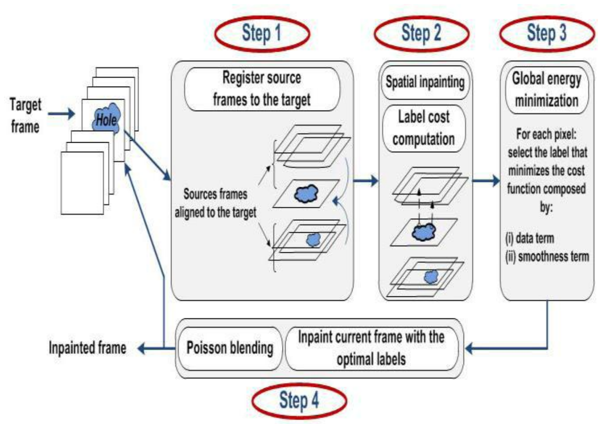

Figure 1: System Architecture

A. *Registration and Hole filling*

This section is devoted to the first step of the algorithm which consists in aligning the neighboring source frames *Is* with the target frame it. An efficient registration method is required since alignment errors can propagate and undermine the spatial and temporal coherency of the in painted areas. In addition, the proposed registration method should be fast enough to provide a reduced complexity video in painting algorithm. To achieve this goal, a new Homography-based registration to handle the alignment problem which is called region based registration.

B. *Region based registration method*

The proposed method aims at being well suited for various viewpoint changes and motion characteristics, while being fast enough to be reasonably considered as a preprocessing step in video editing algorithms. This region-based registration approach is motivated by the recent registration approach proposed. Assuming that the image pair is composed of two dominant planes, perform the alignment by using only two Homography transformations. First, SIFT features are extracted and clustered into two groups based on their spatial positions in the image. Two Homography transformations that map each feature group are computed. These two Homography transformations are then linearly combined. The weight of the linear combination controls on a pixel-basis the contribution of each Homography and depends on the spatial proximity of the closest feature points. The key idea is that neighboring pixels with similar features have to be aligned using the same Homography transformation. This constraint is also used in MRF-based homographic methods thanks to the smoothness term but the spatial consistency is limited to the chosen neighborhood (i.e. 4-neighbors are usually used). To ensure a higher spatial consistency, this project uses a spatial segmentation to determine homogeneous regions. Assuming that a plane is homogeneous in terms of color, such regions may correspond to the actual planes of the scene. For this purpose, the mean-shift algorithm, which is a fast and automatic segmentation tool, requiring only few parameters such as the minimum size of a region, is used.

B. Mean shift algorithm

For each data point, mean shift defines a window around it and computes the mean of data point. Then it shifts the center of window to the mean and repeats the algorithm till it convergens. Mean shift is a nonparametric iterative algorithm or a nonparametric density gradient estimation using a generalized kernel approach. Mean shift is the most powerful clustering technique Mean shift is used for image segmentation, clustering. Mean shift segmentation is an advanced technique for clustering based segmentation.

Figure 2: Without and with poisson blending

D. Poisson blending

Poisson image blending is a popular tool for seamless image Cloning. In this approach, the poisson blending is applied to the in painted result. Interestingly, the poisson blending allows to strengthen the temporal consistency and to increase the robustness of the proposed approach as well. Indeed, once the blending has been performed, replacing the current image by the blended and in painted image into the GoP, as illustrated by above Figure. The quality of the in painted image is improved when the Poisson blending is applied.

5. Conclusion

This proposed project is a novel video in painting method. In a first step, neighboring frames are registered with a region-based Homography. Each plane in the scene is assimilated to a homogeneous region segmented using the mean-shift algorithm. In painting is then performed using a predefined energy cost which is globally minimized. A spatial in painting is used to guide this minimization leading to improve the quality of the in painted areas. The proposed approach has a reduced complexity compared to existing methods. Missing areas are filled in by considering a sliding window of 20 frames.

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