Video Deraining And Desnowing Using Temporal Correlation And Low-Rank Matrix Completion

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Abstract - A video processing is nothing but just the very fast movement of pictures. This project based on frame subtraction method to eliminate the rain streaks in color images using mathematical directional weighted median filter algorithm which involves Erosion and Dilation, based on the study of the existing rain removal method of using Color space and frame subtraction method. First analyzes the characteristics of HSV color images, comparing with the RGB images only V channel is greatly attacked by rain on a rainy video in HSV space, thus translate color image from RGB image into HSV image. Then deal the rain with the new five frame subtraction method on the V channel. But the problem of this paper is rain with the new five frame subtraction method on the V channel and not consider as consecutive frames. In this project to remove rain or snow streaks from a video sequence using temporal correlation. Based on the observation that rain streaks are very small and move too fast to affect the optical flow estimation between successive frames. By using low-rank matrix completion technique, we remove the rain streaks.The proposed algorithm detects and removes rain, snow streaks and reduce noise efficiently.

Keywords— Video deraining, desnowing, Erosion and Dilation,frame subtraction, temporal correlation and low rank matrix completion

I. INTRODUCTION

Video capturing devices, such as smart phones and digital cameras, are relatively cheap and popular nowadays, which facilitate the widespread production and consumption of high quality video sequences. Outdoor video sequences, however, are often degraded due to various weather conditions, e.g. haze, fog, rain, and snow. Image processing and computer vision systems, including tracking and surveillance, may not work properly on these degraded videos. Therefore, attempts have been made to compensate for the weather dependent degradation and enhance outdoor video sequences.

Erosion removes small-scale details from a greyscaleimage but repeatedly degrades the size of boundaries of interest, too. By subtracting the eroded image from the input image, boundaries of each edge region can be found: b = f – (f *s) where f is an image of the regions, s is a 3×3 matrix element, and b is an image of the region boundaries.

The dilation of an image f by a matrix component s (denoted f*s) produces a new greyscale image g = f,s with ones in all locations (x,y) of a matrix element's orogin at which that matrix element s hits the the input image f, i.e. g(x,y) = 1 if s hits f and 0 otherwise, repeating for all pixel coordinates (x,y). Dilation has the viceversa effect to erosion, it adds a edges of pixels to both the inner and outer boundaries of regions.

Morphological algorithm of a greyscale image is analyzed by considering compound operations like opening and closing as filters. They may act as noise reducer. For example, opening with a disc matrix element smooth's corners from the inside, and closing with a disc smooth corners from the outside. But also these operations can filter out from an image any details that are smaller in size than the matrix element.

VISION AND RAIN

The visual effects of rain are complex. Rain produces sharp intensity changes in images and videos that can severely impair the performance of outdoor vision systems. Based on this analysis, we develop efficient algorithms for handling rain in computer vision as well as for photorealistic rendering of rain in computer graphics. We first develop a photometric model that describes the intensities produced by individual rain streaks and a dynamic model that captures the spatio-temporal properties of rain.

Based on their physical properties and the type of visual effects they produce, weather conditions can be broadly classified into steady (fog, mist and haze) or dynamic (rain, snow and hail). In the case of steady weather, constituent droplets are too small (1–10 μm) to be individually detected by a camera. The intensity produced at a pixel is due to the aggregate effect of a large number of droplets within the pixel's solid angle. Hence, volumetric scattering models such as attenuation and airlight (Middleton, 1952; McCartney, 1975) can be used to adequately describe the manifestations of steady weather.

In the last few years, various algorithms have been developed for removing the effects of steady weather from images and for recovering the 3D structure of a scene. In comparison, the effects of dynamic weather (rain and snow) are much more complex and have not been studied in detail. Rain and snow consists of particles that are 1000 times larger (0.1–10 mm) than those in steady weather. At such sizes, individual particles become visible to a camera. Dynamic weather requires models that can describe the intensities produced by individual particles and also capture the spatial and temporal effects of a large number of particles moving at high speeds (as in rain) and with possibly complex trajectories (as in snow).

II.EXISTING METHOD

Existing method combines color image with an improved frame differential method to remove the raindrops in color images using mathematical morphological algorithm, which involves Erosion and Dilation,the rain removal image restoration method of using Color image and frame subtraction method. First analyzes the characteristics of HSV color image, comparing with the RGB image only V channel is affected by rain on a rainy day shooting video in HSV image, thus translate color image from RGB image into HSV image. Following steps

- Read the video
- Segmentation process
- Morphological process
- Translate RGB to HSV image
- Collect V componant ,read the 5 frame subraction method

Then deal the rain with the improved five frame subtraction method on the V channel. Because of th e same pixel on the two repeated frames may not be covered by the same rain .Then introduce the subtraction between average and median in five frame pixel as constraint con dition to detect the rain. This method can be w ell suitable for images with gray scale and no t for RGB images and also only for snowy images

(a) (b) (c)

Fig1:a) input frame b) desnowing result c) rain map

A video is nothing but just the very fast movement of pictures. The quality of the video depends on the number of frames/pictures per minute and the quality of each frame being used.Video processing involves noise reduction, detail enhancement, motion detection, frame rate conversion, aspect ratio conversion, color space conversion etc.

MORPHOLOGICAL PROCESS

There are two main steps follow in morphological process

1. Erosion
2. Dilation

Erosion

The erosion of the binary image *A* by the structuring element *B* is defined by

$$E(A,B) = A\ominus(-B) = \bigcap_{\beta\in B}(A-\beta)$$

Here (A, B) is structural element of the image. Erosion means shrinking the image with same quality, and produces the original image.

Dilation

The dilation of *A* by the structuring element *B* is defined by

$$D(A,B) = A\oplus B = \bigcup_{\beta\in B}(A+\beta)$$

Dilating or eroding without specifying the structural element makes more sense than trying to low pass filter an image without specifying the filter.

This project proposed a method which combines color image with an improved frame differential method to remove the raindrops in color images, based on the study of the existing rain removal image restoration method of using Color image and frame subtraction method. First analyzes the characteristics of HSV color image, comparing with the RGB image only V channel is affected by rain on a rainy day shooting video in HSV image, thus translate color image from RGB image into HSV image. Then deal the rain with the improved five frame subtraction method on the V channel.

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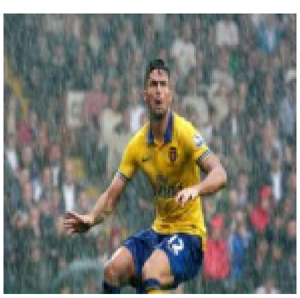
HSV represents the hue, saturation and brightness. As the human visual sensitivity to brightness is far stronger than the sensitivity of the color shade, in order to process and identify color, the human visual system often use the HSV color image, because it is better than the RGB color image.

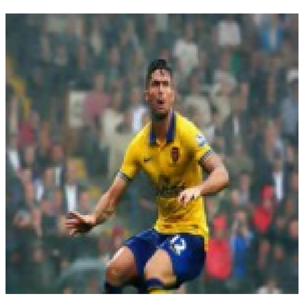
$$H = [3(G-B) / R-G) + (R-B)]$$

$$S = 1-\{min(R,G,B) / V\}$$

$$V = (R+G+B) / 3$$

HSL stands for *hue*, *saturation*, and *lightness*, and is also often called **HLS**. HSV stands for *hue*, *saturation*, and *value*, and is also often called **HSB** (*B* for *brightness*). A third model, common in computer vision applications, is **HSI**, for *hue*, *saturation*, and *intensity*. However, while typically consistent, these definitions are not standardized, and any of these abbreviations might be used for any of these three or several other related cylindrical models.output of the existing method by using morphological algorithem is given by follwoing images.





(a) (b)

Fig 2: a)original image b)deraining image

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III.PROPOSED METHOD

Propose a novel video deraining and desnowing algorithm using temporal correlation and low-rank matrix completion.

Assuming that adjecent frames ,warped by the optical flows, are almost identical with a current frame except for rain streak regions, we generate an initial rain map from the differences between the current frame and the warped adjacent frames. Then, we represent the initial rain map using sparse basis vectors, which are dichotomized into rain streak ones and outliers using a support vector machine (SVM). By removing the outliers, we refine the rain map and detect rain streaks.

(a) (b) (c) (d)

. Finally, we replace the detected rainy pixels using a matrix completion algorithm, which performs the expectation maximization (EM) iterations for the low-rank approximation. Moreover, we extend the proposed videoderaining algorithm to stereo video deraining. Experimental results demonstrate that the proposed algorithm outperforms conventional algorithms, by removing rain streaks efficiently and reconstructing scene contents faithfully.

BLOCK DIAGRAM

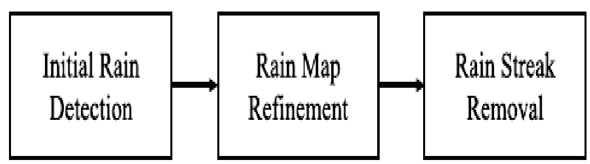

Fig 3:block diagram

Following steps are involed in proposed method by using temporal correlation and low rank matrices.

- Initial Rain Detection
- Rain Map Refinement
- Rain Streak Removal
- Postprocessing

Initial Rain Detection

That rain streaks appear randomly, and each streak occupies a relatively small area in a frame and moves fast between consecutive frames. Also, when a rain streak passes across a pixel, the pixel value becomes brighter than its original color. We can hence detect a rainy pixel, which has a larger value in a current frame than in adjacent frames.

A video sequence may contain dynamic objects or be captured with a moving camera.To compensate for these mismatches between consecutive frames, we warp the previous frame into the current frame by estimating the optical flow field. An optical flow estimation algorithm finds a dense motion field between two consecutive image framesWhen an object appears or disappears between two consecutive frames, the warped frame may contain occluded areas, which cause false detection of rainy pixels.Finally, we obtain an initial rain map as the difference image between the current frame and the hybrid warped frame.

Rain Map Refinement

We can obtain a binary rain mask by thresholding an initial rain map. An initial rain map and the resultant binary rain mask using different thresholds. Note that the binary rain masks contain falsely detected outliers, caused by warping errors or brightness changes between frames, or fail to detect some valid rain streaks. In general, decrease the threshold, many outliers are falsely detected as rain streaks. On the contrary, increase the threshold, we can reduce such outliers but also miss valid rain streaks.

To refine an initial rain map, we exploit the directional property of rain streaks: rain streaks tend to have elliptical shapes, whose major axes deviate little from the vertical direction. In contrast, falsely detected outliers have arbitrary shapes or yield random directions of major axes.Therefore, we can find outliers by comparing the horizontal components with the vertical components of detected ellipses. However, eliminating elliptical regions with large horizontal components may miss actual rainy pixels, since rain streaks and outliers occur simultaneously and may overlap each other.

Rain Streak Removal

compares the initial rain map and the refined rain map, where the refined map suppresses most outliers in the initial map effectively. From the binary rain mask M, we further remove outliers by erasing small connected components of size 5 or less. Then, we perform the dilation operation on the rain mask, since the refinement procedure may distort the boundaries of rain streaks. We restore pixel values, detected as rainy, by exploiting temporal redundancies in adjacent frames. Specifically, we formulate the rain removal as a low-rank matrix completion problem. We first partition the current frame into disjoint blocks.

EM-Based Rain Streak Removal

- **Input** pixel matrix and mask matrix
- **Initialize** pixel matrix
- **Repeat** pixel matrix and mask matrix subtraction
- **Output** repeat the input to output mask matrix and streak removed output

The EM algorithm faithfully recovers rain-free pixel values, as the iteration goes on, even though one of the rain streaks is quite thick.

Postprocessing

Even after the rain streak removal, thin rain streaks, which are not detected in the rain map, may still remain in a derained frame. Various denoising techniques, such as the total variation based denoising, can be applied to remove such thin rain streaks. However, in this work, we employ a simple blurring scheme. The human visual system is more sensitive to thin rain streaks in smooth regions with little texture than to those in highly textured regions.

IV. SIMULATION RESULTS

The deraining results on two selected frames in the “Sing in the Rain” sequence. This sequence is challenging since the camera zooms in gradually toward the man. However, we see that the proposed algorithm successfully removes most rain streaks.

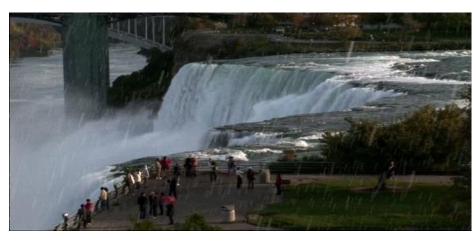

Fig 4:Input Video Frame

An initial rain map detects larger rainy regions, due to outliers, than the corresponding refined rain map. the rain map refinement is an essential step for providing high quality deraining results.

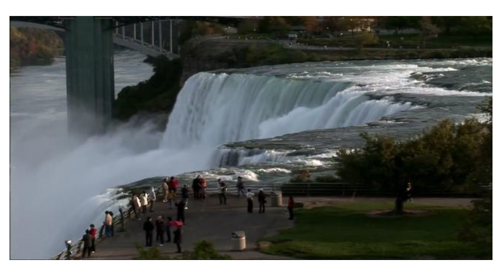

Fig5: Output Image

We see that the proposed algorithm detects and removes rain streaks effectively, and reconstructs the original scene contents faithfully

Fig6: Output rain map difference

V.CONCLUSION

We proposed a video deraining algorithm, which exploits temporal correlation in a video sequence based the low-rank matrix completion. The proposed algorithm obtains an initial rain map, by warping previous and next frames and comparing those warped frame with a current frame. Finally, we remove the detected rain streaks by employing a low-rank matrix completion ,rainy pixels using the EM-based low-rank matrix completion. In this paper we used directional weighted median filter which involves the calculation of SNR and PSNR values. The obtained PSNR value is 80.

REFERENCES

[1] Christo Ananth, A.Sujitha Nandhini, A.Subha Shree, S.V.Ramyaa, J.Princess, "Fobe Algorithm for Video Processing", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE), Vol. 3, Issue 3,March 2010 , pp 7569-7574

[2] J.Chenand L.-P.Chau, "A rainpixel recovery algorithm for video swith highly dynamic scenes,"IEEETrans.ImagePro cess.,vol.23,no.3, pp.1097–1104,Mar.2014

[3] J.-H. Kim, J.-Y. Sim, and C.-S.Kim,"Stereo videode raining and desnowing based on spatio temporal frame warping," in Proc. IEEE ICIP, Oct. 2014, pp. 5432–5436.

[4] J. Mairal, F. Bach, J. Ponce, and G. Sapiro, "Online learning for matrix factorization and sparse coding," J. Mach. Learn. Res., vol. 11, pp. 19–60, Mar. 2010.

[5] K. GargandS. K. Nayar, "Detection and removal of rain from videos," in Proc. IEEE Comput. Soc.Conf.CVPR, Jun./Jul. 2004, pp.I-528–I-535.

[6] L. Xu, J. Jia, and Y. Matsushita, "Motion detail preserving optical flow estimation," IEEE Trans. Pattern Anal. Mach. Intell., vol. 34, no. 9, pp. 1744–1757, Sep. 2012.

[7] N. Surya, Vaishnavi K Video Draining And Disowning Using Morphological Algorithm Assistant professor, Department of Electronics and Communication Engineering(IJARTET)Vol. 3, Special Issue 2, March 2016

[8] S. G. Mallat and Z. Zhang, "Matching pursuits with timefrequency dictionaries," IEEE Trans. Signal Process., vol. 41, no. 12, pp. 3397–3415, Dec. 1993

[9] T. Brox,A.Bruhn, N. Papenberg,and J.Weickert, "High accuracy opticalflow estimation based on a theory for warping," in Proc.8th ECCV,May2004,pp.25–36.

[10] T. Okatani, T. Yoshida, and K. Deguchi, "Efficient algorithm for low-rank matrix factorization with missing components and performance comparison of latest algorithms," in Proc. IEEE ICCV, Nov. 2011, pp. 842–849.

[11] Y. Boykov, O. Veksler, and R. Zabih, "Fast approximate energy minimization via graph cuts," IEEE Trans. Pattern Anal. Mach. Intell., vol. 23, no. 11, pp. 1222– 1239, Nov. 2001

[12] Y. Criminisi, P. Pérez, and K. Toyama, "Region filling and object removal by exemplar-based image inpainting," IEEE Trans. Image Process., vol. 13, no. 9, pp. 1200–1212, Sep. 2004.