USER-ORIENTED STEREO VIDEO REFOCUSING BY COMPUTATIONAL CINEMATOGRAPHIC MODEL

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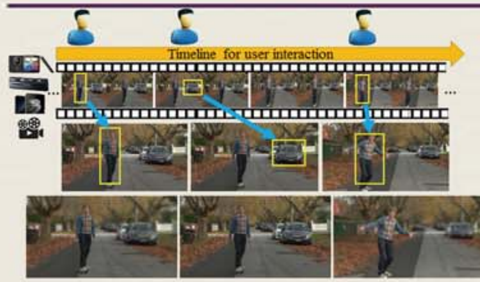
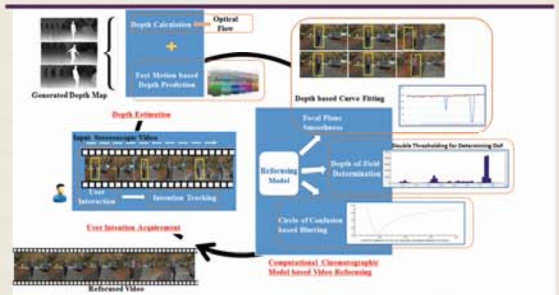
Abstract

Knowing how to make the parts of your videos you want sharp and the parts you want to be out of focus, is a great artistic tool to create great videos. Refocusing, as a most popular photographic technique, is widely welcomed in both photography and cinematography. However, few solutions are designed for the videos captured by common users without professional devices. In this paper, we propose a user-oriented method to facilitate the video refocusing in daily life, with an extra requirement for only stereo cameras which are quite popular today. The performance of the refocused videos compares favorably with the ones generated by the digital single lens reflex (DSLR).

User-Oriented Stereo Video Refocusing



Framework



Algorithm

·Depth Estimation--For keeping the consistency of depth and improving the computing efficiency as much as possible, we propose an optical flow based depth prediction method to leverage the computing efficiency and the depth accuracy. The label for deciding calculation or prediction is calculated as follows, where *h* is the descriptor of histogram of oriented optical flow (HOOF).

$$p(i) = \begin{cases} 1, & S(h_i, h_{i-1}) < \tau \\ 0, & \text{otherwise} \end{cases}$$

And the predicted depth is calculated by motion-based interpolation.

$$D_{i+1}(x,y) = D_i(x - v_x, y - v_y)$$

·Focal Smoothness based User Intention Tracking--A good refocused video should have an organized change of focus, i.e., the trajectory of focus in depth space among the neighboring frames should present disciplinary changing. The selected region customized by the user is initialized to be the focal plane and it is tracked by the tracking method. However, most existing tracking methods can indeed track the exact object while they can not localize them very well. Therefore, a depth aided focal smoothness based user intention tracking algorithm is introduced in this paper.

$$R = \{R(c_1,1), R(c_2,2), ..., R(c_i,i), ...R(c_n,n)\}$$

$$F_i = \{f_m | f_m \in R(c_i,i), D(f_m) = Mode(R_i, D)\}$$

·Depth of Field based Circle of Confusion Blurring--In order to achieve DSLR-like effect, it is significant to understand the blurring principle in optics. Circle of confusion is the concept. From the view of optics, it is an optical spot, while from the view of imagery, it is a blur spot. The blurring area is related to the depth-of-field (DoF), and can be calculated as follows.

$$DoF = \begin{cases} [0, t_2+\xi] & 0 < d_m(R) < t_2 < t_1 < S \\ [t_2+\varepsilon, t_1+\xi] & 0 < t_2 < d_m(R) < t_1 < S \\ [t_1+\varepsilon, t_2+\xi] & 0 < t_1 < d_m(R)+\xi < t_2 < S \\ [t_2+\varepsilon, S] & 0 < t_1 < t_2 < d_m(R) < S \end{cases}$$

Let *C* represent the radius of circle of confusion, the relationship of *C* and each depth value *D(x,y)* can be denoted below.

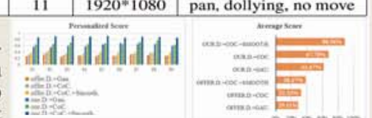
$$C = A\frac{|D(x,y) - f|}{2D(x,y)}$$

Experiments

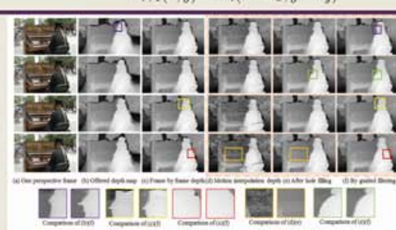
Dataset--An integrated dataset collected from multi sources including all the basic shot types in cinematography.

Source	Num.	Resolution	Shot types
UUni. Nantes	12	1920*1080	tracking, no move
RMIT	24	1920*1080	pan, no move, dollying tilt, pull back, tracking
Others	11	1920*1080	pan, dollying, no move

User satisfaction-- Nine volunteers are invited to participate in user feedback study to evaluate six different methods.



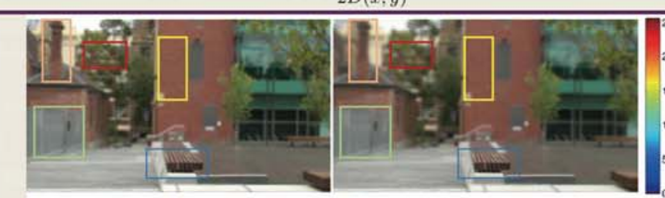
(a) Scores for each method given by 9 subjects (b) Scores for each method averaged by 9 subjects



The comparison between the calculated depth provided in the dataset and the proposed method. The last row shows some enlarged comparisons.

(a) The process of generating video refocusing results (b) Depth-Time curve

The comparison between the video refocusing results without and with focal smoothness based on user intention tracking.



(a) Gaussian blur based refocusing (b) Circle of confusion based refocusing

The comparison of pattern of blurring, widely used Gaussian Blur and DSLR-like Circle of Confusion. The fader bar represents the changes of distance to the camera lens varying from blue (near) to red (far).

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