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A 2D to 3D Video Converter using Optical Flow Information and Least Squares Regression

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Introduction

- People are paying increasing attention to 3D visual technology.
- Three-D media contents are comparatively more attractive than traditional media.
- Current methods to model 3D scenes include hardware solutions such as dual lens cameras and motion capture systems and software solutions such as Maya and 3Ds max.
- For existing 2D media, however, we can only develop a particular method to transfer it from 2D to 3D. This can also be an economic method to produce 3D contents

Related Work

- Tsai et al. analyzed the line positions to separate the foreground and background parts in an image frame, and produced some successful transfer cases [Tsai et al. 2011].
- Iwabuchi et al. proposed a multi-angle tracking method for matching depth grades to2D objects in 2012 [Iwabuchi et al. 2012].
- Jung and Cai compared color cue information with a well-trained color database for assigning depth values to super-pixels in 2015 [Jung and Cai 2015].
- Methods were developed by incorporating consideration of reflected light and using KNN, K-mean techniques to update the color feature extraction [Herrera et al. 2016].
- Optical flow information was useful to determine the distance between the object and the lens [Horn and Schunck 1981]. This suggested that optical flow can be a promising feature for 2D-to-3D conversion and thus we develop a method that converts an existing 2D video to a 3D version by using optical flow information and least squares regression in this paper.

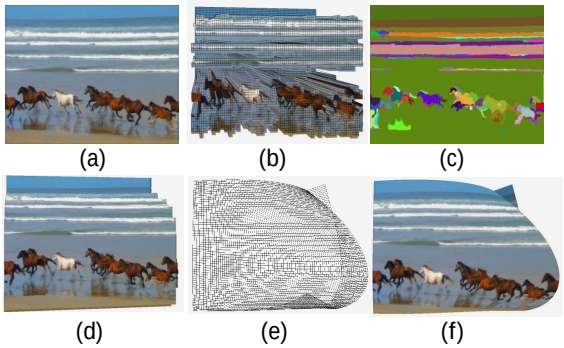
References

- Dorin Comaniciu and Peter Meer. 2002. Mean Shift: A Robust Approach Toward Feature Space Analysis. IEEE Transactions on Pattern Analysis and Machine Intelligence 24, 5 (May 2002), 603–619.
- Jose L. Herrera, Carlos R. del Blanco, and Narciso Garc?a. 2016. A novel 2D to 3D video conversion system based on a machine learning approach. IEEE Transactions on Consumer Electronics 62 (Nov. 2016), 429–436.
- Berthold K. P. Horn and Brian G. Schunck. 1981. Determining Optical Flow. Artificial Intelligence 17 (1981), 185–203.
- Yuka Iwabuchi, Li Li, and Kozo Ohtani. 2012. 3D Shape Measurement Algorithm of Transparent Object Exclusively Using Reflected Light. In Proc. the 2012 SICE Annual Conference (SICE 2012). 1243–1247.
- Cheolkon Jung and Jiji Cai. 2015. Superpixel matching-based depth propagation for 2D-to-3D conversion with joint bilateral filtering. In Proc. the 2015 IEEE International Conference on Image Processing (ICIP 2015). 3515–3519.
- Sung-Fang Tsai, Chao-Chung Cheng, Chung-Te Li, and Liang-Gee Chen. 2011. A real-time 1080p 2D-to-3D video conversion system. IEEE Transactions on Consumer Electronics 57, 2 (May 2011), 915–922.

Our Method

- Our method includes the following pipelined processes.

1) Read the video into frames.
2) Calculate the optical flow values for each particular frame.
3) Assign six grades, from 0 to 5 with uniform steps, as the depth values to the corresponding pixels.
4) Use the mean-shift technique to partition a given image frame into superpixels, and assign the maximum depth grade thereof to everywhere of the same mean-shift region.
5) Smooth the change of depth by building a high order polynomial surface according to the depth map.
6) Render the reorganized 3D video.



Intermediate results of our method. (a) original frame, (b) optical flow values, (c) super-pixels resulting from mean shift process, (d) depth map with depth values assigned onto mean-shift superpixels, (e)(f) 3D model built by least squares estimation, where we cue the twisted surface at an angle of 10◦ to enhance the 3D presentation.

Experimental Results

- The top row presents original video frames. The middle row shows the 3D surfaces after conversion, which are rotated by 10◦ for the reader's easy observation. The bottom row patches the frames onto the transferred 3D surfaces.
- For practical 3D video conversion, we may only need a slight rotation, a rectangular cut-off and a resolution retargeting process.