Stereoscopic Line Drawing using Depth Maps

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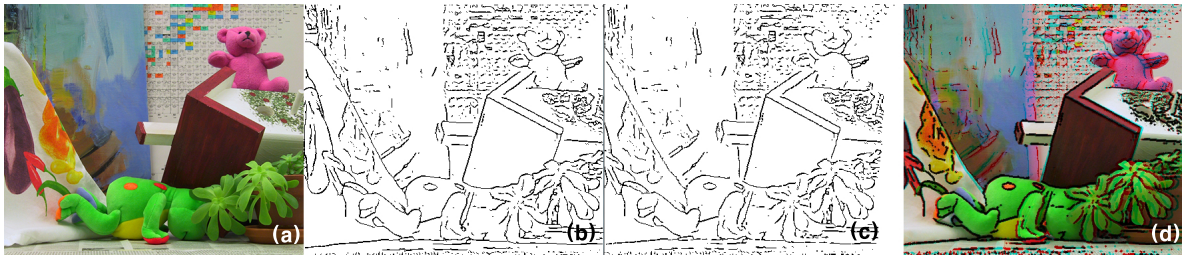

Figure 1: *(a) Original Image (Left) (b) Stylized edge using Coherent Line Drawing (Left) (c) Warped edge (Right) (d) Final Result (Red-Cyan Stereoscopic Image)*

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1 Introduction

Motivated by the success of the recent stereoscopic 3D films, there is a growing demand for techniques for creating and editing 3D contents. Several researchers have attempted to improve existing 2D image processing methods in order to apply them to the stereoscopic 3D images.

A naive extension of the 2D image stylization technique to 3D imagery is to apply it to each left and right image independently. When watching the resulting images using Stereoscopic Device, the fused 3D image is too poor to be perceived as a 3D image, because the resulting left and right images usually differ from each other. Specically, if the left and right images have different lines, the binocular rivalry phenomenon occurs, which disturbs the fusion of the left and right images and causes visual fatigue. Therefore, in order to draw consistent lines, we should take into consideration the stereo correspondence of the left and right images.

In this work, we propose a method that can stylize a stereoscopic image by drawing lines and obtaining cartoon-stylized results. The key idea is to generate the vectorized lines from left image, warp it into right image, and manipulate line width by depth. Using the new method, we can obtain well-fused 3D image, so there is no binocular rivalry phenomenon. Also, with line width control, we can get more viewing exprience.

2 Our Approach

For a given stereoscopic pair of left and right images(Figure 1(a)), which are rectified in order to remove vertical disparities, we first obtain dense correspondences between the two images [Rhemann et al. 2011]. We can apply image warping to the stylized left image in order to generate the stylized right image that have consistent lines by using the disparity map.

Then, we perform image stylization by using the ETF field [Kang et al. 2007](Figure 1(b)). Although this paper uses the image stylization method based on the ETF field, other methods can be used, such as Bilateral Filtering, DoG filtering, canny edge detectors.

To warp left image into right one without distortion, our method extracts the vectorized lines from the detected edges, which have its own orientation and magnitude on each edge point. Then the vectorized lines are warped to right image using computed disparity map without occluded region(Figure 1(c)).

Because line is vectorized, line width can be manipulated. Therefore, we can apply additional effects to the stylized result. Cartoon artists usually express the distance from the camera to an object as a line width and intensity; objects near the camera are drawn with thick black lines, while objects far from the camera are drawn with narrow gray lines. Thus, we use the disparity map to control the line width and intensity. Finally, we draw our warped edge on original right image(Figure 1(d)).

3 Conclusion

Using our approach, two images can be rendered consistently. Additionally, our line manipulation method can express the distance of objects effectively. The user survey shows that our stylized images are perceived more comfortably in 3D than those generated by stylizing left and right individually.

In future work, we would like to extend our method to other NPR techniques, such as painterly rendering or mosaics rendering. While the proposed method does not make stylized edge in occluded region, we should consider it when we attempt to render images with large occlusion.

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References

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