Color Curtains for Providing Enhanced Depth Information

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***Abstract*—We perceive depth from dual channel image sequences through both eyes. Most of display monitors in daily life can output single channel image sequences only. We propose a method for providing enhanced depth with color control along with depth.**

Keywords-depth perception; visual compensation; augmented reality

I. INTRODUCTION

We perceive depth from many kinds of cues, such as color, blur, shade, and so on. Disparity between two channel images is a strong cue of depth.

We have proposed depth enhancement by blurring for providing depth information for people losing sight in one eye[1]. The device, called mono-glass, can support to perform a task that requires sense of distance. However, the blurring degrades detailed textures in synthesized images. Depth unsharp masking[2] also represents enhanced depth information. It employs unsharp mask driven by depth map, however it can represents relative depth information between neighboring objects. A lot of tasks require the information of absolute depth instead of the perception of relative depth.

II. COLOR CURTAINS FOR DEPTH ENHANCEMENT

We employ coloring for enhancing depth information. Our proposed color curtains that consist of three color layers. The overview is shown in Fig 1.

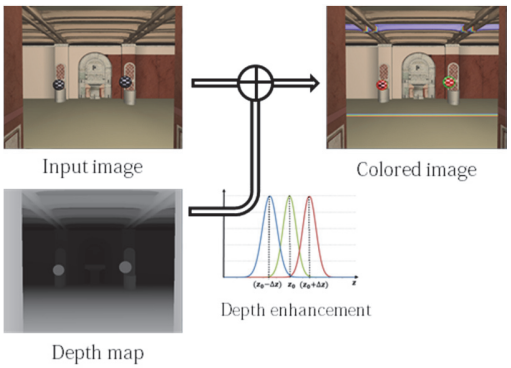


Figure 1. Depth enhancement with color curtains.

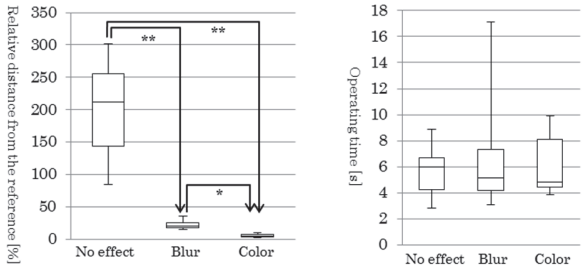
A user defines a virtual target distance z_0. The object at z_0 is colorized in green. At z_0, the user can clearly grasp the depth on the distance. The object right before z_0 is colorized in red, and the one right behind z_0 is colorized in blue. Color cues are provided by the user putting an object at z_0. At the distance, the object is colorized as if there are three transparent curtains.

c for the strength of coloring, σ for the width of colorized area, and Δz for red and blue curtains are defined in advance by the user. If the object is at z, colors as follows are added to the objects.

$$\Delta R = c \cdot e^{\frac{(z-z_0+\Delta z)^2}{2\sigma^2}}, \Delta G = c \cdot e^{\frac{(z-z_0)^2}{2\sigma^2}}, \Delta B = c \cdot e^{\frac{(z-z_0-\Delta z)^2}{2\sigma^2}}. \quad (1)$$

III. EXPERIMENT

7 subjects (university students, healthy both eyes) joined our experiment. They sat on a seat fixed at a certain distance from a display monitor. Two balls are displayed as shown in Figure 1. The left ball is moved back and forward by dragging a mouse. When they judge the depth of two ball are the same, they press the enter button. Fig 2 shows (1) subjects could position the ball at right distance when colorized image sequences were displayed, and (2) there were no significant difference of operating time between the cases that the images with blurring, coloring or no effect were displayed.



(a) Error of Position (b) Operation time

Figure 2. Experimental result. *: 5%, **: 10%.

ACKNOWLEDGEMENT

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