Interpolation Method of Offset using Bicubic in Glasses-less 3D Display

Isao Nishihara
Department of Information Systems Engineering, Faculty of Engineering
Toyama Prefectural University
Imizu City, Toyama 939-0398, Japan
nishihara@pu-toyama.ac.jp

Asuka Fukatsu
Department of Information Systems Engineering, Faculty of Engineering
Toyama Prefectural University
Imizu City, Toyama 939-0398, Japan
t715061@st.pu-toyama.ac.jp

Takayuki Nakata
Department of Information Systems Engineering, Faculty of Engineering
Toyama Prefectural University
Imizu City, Toyama 939-0398, Japan
nakata@pu-toyama.ac.jp

***Abstract*— In this paper, we applied the bicubic method to interpolate discrete offset values instead of the previously used bilinear method in 3D display calibration. We also attempted to interpolate the outer regions with the continuous method as much as possible. This further improved the image quality for stereoscopic viewing.**

***Keywords*— Glasses-less 3D viewing systems; Auto stereoscopy; Large display; Local mapping; Software offset adjustment**

I. INTRODUCTION

In large scale glasses-free 3D displays, it is important to deal with local displacements caused by lens distortions and other factors due to the increasing size of lenticular lenses. In the calibration of 3D displays, this paper proposes the use of three-dimensional interpolation to improve image quality. In a previous paper [1][2], the bilinear method was used to apply offset values in each center points of local area to the entire screen. A simple extension was used for the surrounding areas, and the same values were used for areas further out. However, this method causes discontinuities in the offset values on the boundaries between local areas. On the other hand, since lenticular lenses are originally made as an integral part, all distortions can be continuous. Therefore, it is likely that the overall continuity does not match the actual lens distortions. In this paper, the bicubic method is applied to interpolate the discrete offset values. We also attempted to interpolate the outer areas as continuous method as possible. This has resulted in further improvements in image quality for 3D viewing.

II. EXPERIMENT

The interpolation method was implemented and measured. Figure 1 shows the interpolation results for each offset value at horizontal position. Since [1][2] uses two-dimensional interpolation, there is a linear change and a large discontinuity at the measurement point. The proposed method adopts a smooth interpolation without discontinuity. As a result, the continuity of the lenticular lens is more accurately reflected and a high-definition three-dimensional stereoscopic display is achieved.

Figures 2 and 3 are images with each offset value filtered by a Laplacian. The closer to black, the more discontinuous the interpolation value is. In the bilinear image in Fig. 2, black lines are lined up on the squares, but in the bicubic image in Fig. 3, the brightness changes smoothly. The maximum absolute error of the Laplacian operation is reduced from 0.006789 to 0.000078 (subpixel), which is expected to improved 3D image quality.

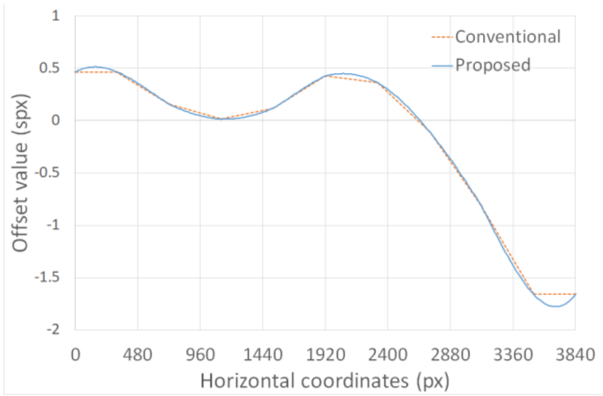

Fig. 1 Interference result of each offset value

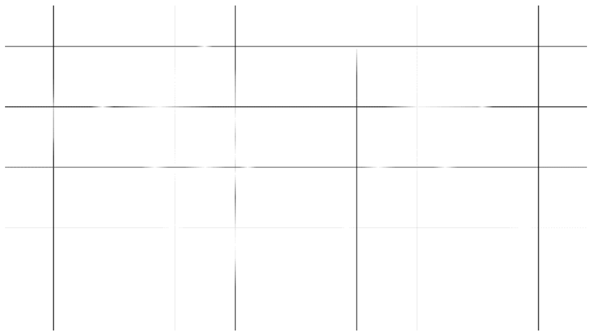

Fig.2 Offset value image with Laplacian (bilinear)

Fig.2 Offset value image with Laplacian (bicubic)

REFERENCES

[1] Takayuki Nakata, Isao Nishihara, “Dynamic Image Adjustment Method and Evaluation for Glassless 3D Viewing Systems,” IEICE TRANSACTIONS on Information and Systems, Vol.E103-D, No.11 pp.2351-2361, 2020. DOI: 10.1587/transinf.2019EDP7204

[2] Isao Nishihara, Takayuki Nakata; "Fast and Precise Local Mapping Method For Glassless 3D Viewing System," International Workshop on Advanced Image Technology (IWAIT 2017), Poster 2B , 28, Penang Malaysia, Jan. 2017.