Display of Diamond Dispersion Using Wavelength-division Rendering and Integral Photography

Nahomi Maki and Kazuhisa Yanaka
Kanagawa Institute of Technology

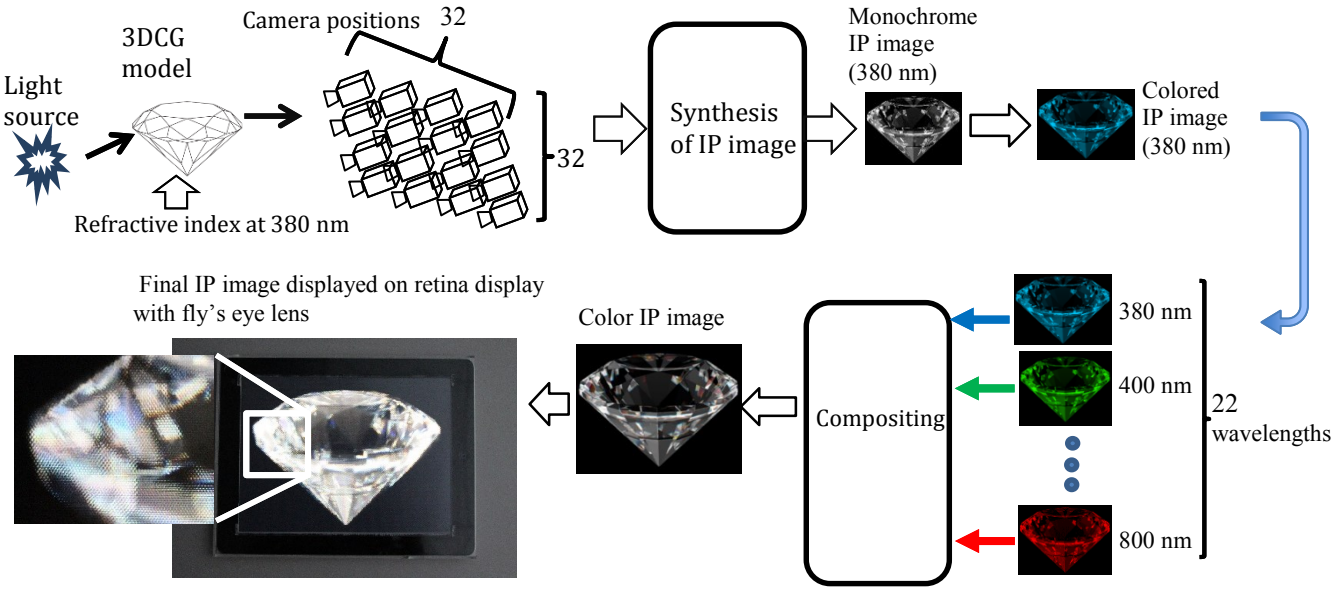

Figure 1. *Block diagrams of the proposed system.*

1. Introduction

Various colors, such as in a prism, are observed in properly cut diamond even under white light because of dispersion. Properly-cut diamond brings about scintillation when viewing angle is changed, because total reflection inside a diamond tends to occur frequently due to the large refractive index. Moreover, strong rainbow colors are seen because of high dispersion ratio.

However, diamonds are difficult to express by conventional 3DCG because of the two following reasons. First, common 3DCG applications usually do not have dispersion rendering function based on physical laws. Second, a single 3DCG image does not have information of views seen from different camera positions. To overcome these difficulties, we propose a new method in which dispersion rendering and integral photography (IP) are integrated.

2. Method

Given that dispersion is caused by the difference of refractive index of each wavelength, we adopted our wavelength division rendering method [MAKI and YANAKA 2014], in which the wavelength of visible light from 380 nm to 800 nm is divided into 22 wavelengths, the bandwidth of each is 20 nm. This method is physically correct when the bandwidth is narrow enough. As shown in Fig. 1, when images at 380 nm, for example, are rendered, the refractive index of a diamond is set at 380 nm. Then, the diamond is rendered from 32×32 camera positions, and an IP image at 380 nm is synthesized according to the extended fractional view method [YANAKA 2008]. Similarly, IP images at other wavelengths are synthesized. A color IP image is obtained by composing 22 IP images, each of which corresponds to each wavelength. When the IP image is displayed on a retina display (9.7 inch, 2048 × 1536 pixels) on which a hexagonal fly's eye lens (lens pitch: 1 mm) is placed, an auto-stereoscopic image of a diamond that has both dispersion and scintillation is observed.

e-mail: {maki, yanaka} @ic.kanagawa-it.ac.jp

SIGGRAPH 2015 Posters, August 09 – 13, 2015, Los Angeles, CA.
ACM 978-1-4503-3632-1/15/08.
http://dx.doi.org/10.1145/2787626.2792642

3. Animation

IP enabled users to observe 3DCG objects from various directions. However, the visible area is not very wide because of technological disadvantages of IP. Therefore we introduced an animation in which the diamond rotates horizontally, so that users can see the diamond from anywhere (i.e., 360 degrees). As a result, the effect of scintillation is enhanced.

4. Conclusions

By using the developed method, in which dispersion rendering and IP are integrated, a superb auto-stereoscopic image of a diamond that has both dispersion and scintillation is observed. Thus, IP is beneficial not only for displaying auto-stereoscopic images but also for expressing dispersion and scintillation based on physical laws. This system could be applied to display valuable gem stones electronically at jewelry stores without risk of theft or at online shops in the future.

References

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YANAKA, K. 2008. Integral photography using hexagonal fly's eye lens and fractional view, Proc. SPIE 6803, Stereoscopic Displays and Applications XIX, 68031K,pp.1–8.