A Method to Generate Hybrid Pointillistic Images

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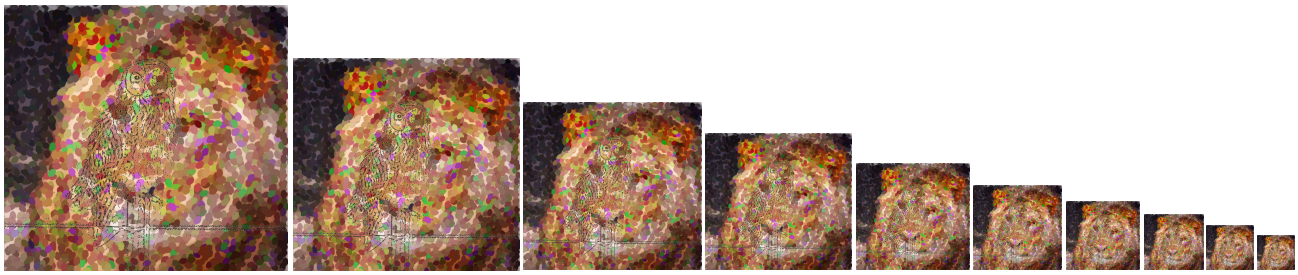

Figure 1: *Example of hybrid pointillistic images.*

1 Introduction

A hybrid image is an image that changes interpretation as a function of viewing distance [Oliva et al. 2006]. Hybrid image I_H obtained by superimposing two images, I_1 and I_2, is represented as follows:

$$I_H = L_P(I_1) + H_P(I_2), \quad (1)$$

where L_p is a low-pass filter and H_p is a high-pass filter. The low-pass filtered blurred image is seen by viewers at a far distance, and the high-pass filtered sharp image is seen by viewers closer to the display.

In this study, we propose a method to generate *hybrid pointillistic images* that are non-photorealistic style hybrid images (see Fig. 1). Hybrid pointillistic images are generated by superimposing two non-photorealistic images; one is pointillistic for far viewers, and the other is stippled for near viewers.

2 Proposed Method

To change the perception of the images according to viewing distance, blurred and sharp images are required. The blurred and sharp images are obtained by altering the sizes of the dots that make up the images. Thus, using large dots creates a pointillistic blurred image, and using small dots creates a stippled sharp image.

Figure 2 shows the flow of our hybrid pointillistic image generation method. Hybrid pointillistic image I_{HP} is generated from two input images, I_1 and I_2, which is expressed as follows:

$$I_{HP} = P_H(I_1) + S_{PS}(H_P(I_2)), \quad (2)$$

where P_H is created using a pointillisitic halftoning method [Sugita and Takahashi 2013], and S_{PS} is created using a structure-preserving stippling method [Li and Mould 2011].

2.1 Generating pointillistic images for far-distance viewing

We generated a pointillistic image for far-distance viewing using a pointillistic halftoning (PH) method. PH is a method for applying an error-diffusion algorithm to random sampling dots to achieve a pointillistic appearance. Pointillistic images with large dots appear as a blurred image, such as a mosaic image. A problem with hybrid images is that the blurred images can still be perceived by viewers at a close distance. To prevent viewers who are near from perceiving an image that is meant to be perceived from far away, applying an error-diffusion method works well.

2.2 Generating stippled images for near-distance viewing

We generated a stippled image for near-distance viewing. First, we applied a high-pass filter to the input image to generate a high-frequency (HF) map. Next, an error-diffusion method was applied to the HF map. We adopted a structure-preserving stippling (SPS) method for error-diffusion, because an SPS method can express the structure of the input image and control the density of dots by altering several parameters. When stippling is directly generated from an input image, the desired change of perception of the two images based on distance does not occur.

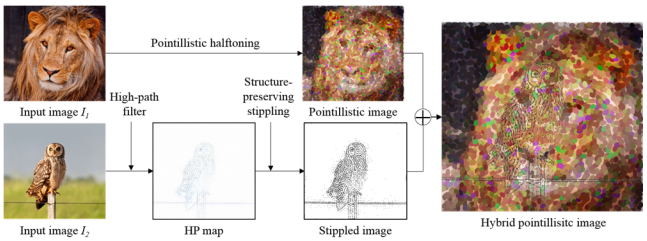

Figure 2: *Hybrid pointillistic image generation.*

3 Results

Figure 1 shows the hybrid pointillistic image that we generated. The original size of the image was 1024 × 957 pixels. The radius of dots used to create the pointillistic image was 14 pixels, and the radius of the dots used for stippling was 1 pixel. When viewed from up close, an owl is perceived from a stippled image. When the viewer steps a meter away, he or she sees a lion depicted in a pointillistic image. Instead of having the viewer step away, we can simulate that action by downscaling the image gradually. Suddenly, at a certain distance (or size of the image), the perception of the image is changed.

References

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