Depth-based Anisotropic Kuwahara Filtering

Jeong-ho Ahn *
Yonsei University

Jong-Chul Yoon†
Yonsei University

In-Kwon Lee‡
Yonsei University

(a)　　　　　　　　　(b)　　　　　　　　　(c)　　　　　　　　　(d)

Figure 1: *Image abstraction comparsion between anisotropic kuwahara filtering and depth-based anisotropic kuwahara filtering: (a) original image; (b) depth map; (c) image abstraction result using anisotropic kuwahara filtering; (d) image abstraction result using depth-based anisotropic kuwahara filtering.*

1 Introduction

When artists draw a picture of photorealistic scene in an image, they describe only specific parts that represent characteristic features carefully, but they express the parts about less important region roughly. In study about Non-photorealistic rendering, image abstraction research reflects such artist's character. Thus, methods about image abstraction commonly preserve image features and flatten non-feature area. Recently, Kyprianidis et al. [2009] introduced Anisotropic Kuwahara Filtering(AKF) which generates feature preserved image abstraction using the smoothed structure tensor. However since they used only color information to defining anisotropic ratio, different regions that have similar color are conquered by each other unintentionally. Hence, we propose the depth-based AKF method that considers not only color, but also depth to generate image abstraction where boundary feateures are effectively preserved.

2 Description

Notice that details of AKF algorithm can be found in [Kyprianidis et al. 2009]. We modified this algorithm to improve the shape conservation in image abstraction. When the color of an image object is almost completely similar to background color, the result of AKF is prone to mix up both regions. because only color information of each pixel on an image is considered. To overcome this limitation, we consider the depth of an image. First of all, we find depth discontinuity of contents from the depth map in an image using the method by [Zhang et al. 2008]. Using this discontinuity energy, we sharply designed anisotropic kernel to preserve important parts of an image. We also reduce the size of kernel for weak filtering about feature region. For implementation, we replace 2D matrix S of [Kyprianidis et al. 2009] to S' by using depth discontinuity $d \in [0, 1]$ as follows:

$$S' = \begin{pmatrix} \frac{(1-d)^{w_1}}{1+w_2 \cdot d} & 0 \\ 0 & (1-d)^{w_1} \end{pmatrix} S \qquad (1)$$

where S' is improved kernel ratio by our method. w_1 denotes the kernel scaling factor. Based on the depth discontinuity, it makes the smaller size of kernel to weaken the filtering effect. The parameter w_2 is an elliptic slightness factor where it is closer to feature's outline, to preserve image shape boundary. We replace S' in existing AKF algorithm, This novel ratio can effectively preserve the shape features of image contents.

3 Result and Future Work

Figure 1 shows a comparison of image abstraction using AKF and our method . Each output image in Figure 1 is generated by AKF with three times of iterated step. Since AKF does not use depth information, it fails capturing depth discontinuity of image contents and that cause the similar colors are merged by increasing number of iteration (Figure 1(c)). But our depth based-method shows enhanced boundary preservation, as well as emphasis of people's border details (Figure 1(d)).

Although we use existing method forming an anisotropic filter based on 2D tensor information and improve performance by depth information, future research will be concentrate on making an anisotropic filter based on 3D tensor map only using depth information.

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References

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*e-mail:macro516@cs.yonsei.ac.kr
†e-mail:media19@cs.yonsei.ac.kr
‡e-mail:iklee@yonsei.ac.kr