3D 가우시안 스플래팅에서 투명도 임계값에 관한 연구

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Transparency threshold in 3D Gaussian Splatting

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Abstract

3D Gaussian splatting is a recent technology used for reconstructing 3D spaces. It involves adjusting or removing Gaussian distributions based on points to complete the space. The criterion for deleting Gaussian distributions relies on 'a' values, representing transparency. Distributions with transparency below the defined threshold 'a' are deleted. This study aims to examine how results differ based on the threshold value. In image processing, noise handling is crucial, and as 3D Gaussian splatting works with this noise, it's anticipated to produce similar effects. Ultimately, lower threshold values led to better outcomes. This was due to limitations in implementing detailed designs and datasets generated by cameras. This study may serve as a reference for future research in 3D Gaussian splatting.

Ⅰ. Introduction

3D Gaussian splatting is a technique gaining traction for reconstructing 3D spaces [1]. It utilizes point clouds from monocular images to generate points with Gaussian distributions, reconstructing the 3D space [2]. By applying Gaussian distributions around these points, objects are formed using split or clone methods. Transparency is a crucial factor in this process, defining the depth and distance of objects [3]. In this study, we aim to assess how adjusting the transparency threshold impacts the quality of 3D space reconstruction, particularly for scenes not directly aligned with the camera.

Ⅱ. Methods and Experiment : Transparency Impact

In this study, we adjusted the transparency threshold in 3D Gaussian Splatting, testing various values: 0.0005, 0.001, 0.005, 0.01, and 0.05, while maintaining constant parameters. These changes affected Gaussian distributions, shaping objects in the 3D space through split or clone methods. Generated images, originating from a video centered on our lab's chair, were compared with real photos from the same viewpoint using Unity. While noting potential discrepancies due to the creation process, our study aimed to assess the generated images' resemblance to reality.

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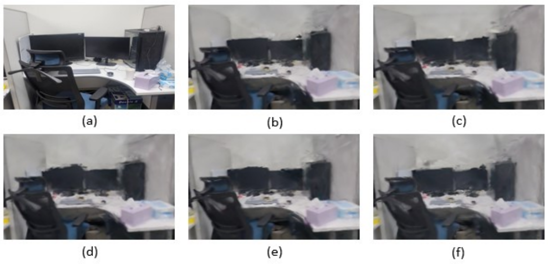

Figure 1 : image dataset (Unity), (a) real image, (b) a=0.0005 Generated image, (c) a=0.001 Generated image, (d) a=0.005 Generated image, (e) a = 0.01 Generated image, (f) a = 0.05 Generated image

The image dataset used in the experiment consisted of 100 images dataset, of which (a)~(f) in Figure 1 represent a subset. In Figure 1, (b)~(f) is the image generated, and (a) is the picture of the same composition as the image generated. We will find out how similar (b)~(f) generated with different transparency thresholds is to (a). We will compare it with three things: PSNR, which measures the signal-to-noise ratio between images, SSIM, which evaluates the structural similarity between the two images. All high values show good results.

Table 1 : Average values for all 100 datasets

alpha	0.0005	0.001	0.005	0.01	0.05
PSNR	13.4	12.3	11.8	11.5	11.1
SSIM	0.51	0.48	0.47	0.44	0.42

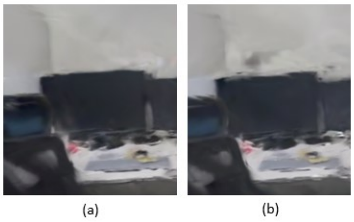

Figure 2:(a) a=0.0005 image, (b) a=0.05 image

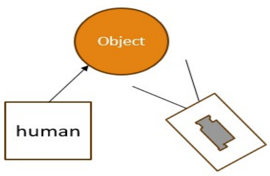

Figure 3 : Different viewpoints for data collection and scene observation

Decreasing the transparency threshold, 'a,' in Table 1 enhances results, improving both PSNR and SSIM metrics. Figure 2 illustrates this trend: as 'a' reduces, PSNR and SSIM increase. Higher alpha values relate to lower metrics. Higher 'a' values erase finer object details like edges, affecting object clarity and degrading video quality. In 3D Gaussian Splatting, objects involve multiple Gaussian distributions rather than one. Raising the threshold might erroneously remove these distributions as noise. Gaussian distributions prioritize areas from the initial camera view, causing deletions in Unity when angles change (Figure 3). This can lead to incomplete walls when zoomed in.

Ⅲ. Conclusion

In conclusion, decreasing the transparency threshold ('a') led to improvements in PSNR and SSIM values, enhancing video quality. Moreover, higher thresholds erroneously identified multiple Gaussian distributions as noise, leading to their removal. Additionally, when specific camera angles were missed, certain objects were deleted, resulting in incomplete structures like incomplete walls. These findings suggest that lower transparency thresholds aid in preserving finer details accurately [4]. However, further research with expanded datasets is needed to comprehensively assess 3D Gaussian Splatting.

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