







filters proposed in [6, 7, 8] showed numerically superior performance, but showed a fatal problem in generating artifacts in the mirror portion, as shown Fig. 4. Therefore, it was confirmed that the performance of the tent filter was superior to those of the other filters.

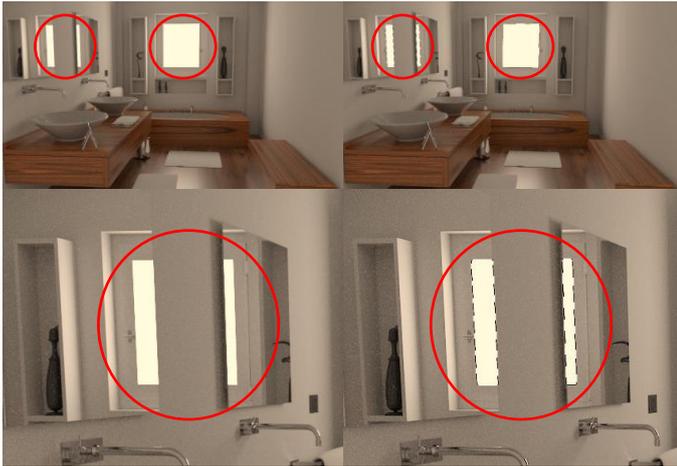


Fig. 4. Artifacts occurred case from filtering results

TABLE II. COMPARISON RESULTS OF SIX SAMPLING METHODS

	<i>bathroom2</i>		<i>classroom</i>	
	PSNR	Time	PSNR	Time
Independent sampler	34.30	15.69	33.87	13.96
Low discrepancy sampler	34.40	15.83	34.00	14.19
Stratified sampler	34.42	16.33	34.04	14.61
Halton QMC	34.40	16.60	34.06	14.70
Hammersley QMC	34.42	16.58	34.09	14.70
Sobol QMC	34.44	17.41	34.09	15.52

(Unit: db(PSNR), min(Time))

TABLE III. COMPARISON RESULTS OF SIX FILTERING METHODS

	<i>bathroom2</i>		<i>classroom</i>	
	PSNR	Time	PSNR	Time
Box filter	33.29	15.78	32.45	14.19
Tent filter	34.39	15.81	34.00	14.19
Gaussian filter	34.71	16.16	34.61	14.64
Mitchell-Netravali filter	34.08	15.99	33.27	14.35
Catmull-Rom filter	33.87	16.05	33.45	14.34
Lanczos Sinc Filter	34.76	16.31	34.19	15.02

(Unit: dB(PSNR), min(Time))

## V. CONCLUSION

In this paper, we have compared and analyzed the method of performing sampling and filtering as post-processing of the rendering result obtained by the volumetric rendering. As the sampling method, we have analyzed random-based sampling,

such as independent sampling and stratified sampling, and the Quasi-Monte Carlo-based sampling method, such as low discrepancy sampling, the Hammersley's method, the Halton's method, and the Sobol's method. As the filtering method, we analyzed the Mitchell-Netravali filter, the Catmull-Rom filter, and the Lanczos Sinc filter as well as the box filter, the Gaussian filter and the tent filter, which are widely used for image processing. Experimental results show that the low discrepancy sampler is faster than the other samplers of similar PSNR performance by about 30 seconds, and is the most optimal sampler. Unlike several filters that generate artifacts in the boundary area, the tent filter performs fast and accurate filtering without generating any annoying artifacts.



Fig. 5. Noise reduction results using low discrepancy sampler and tent filter

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