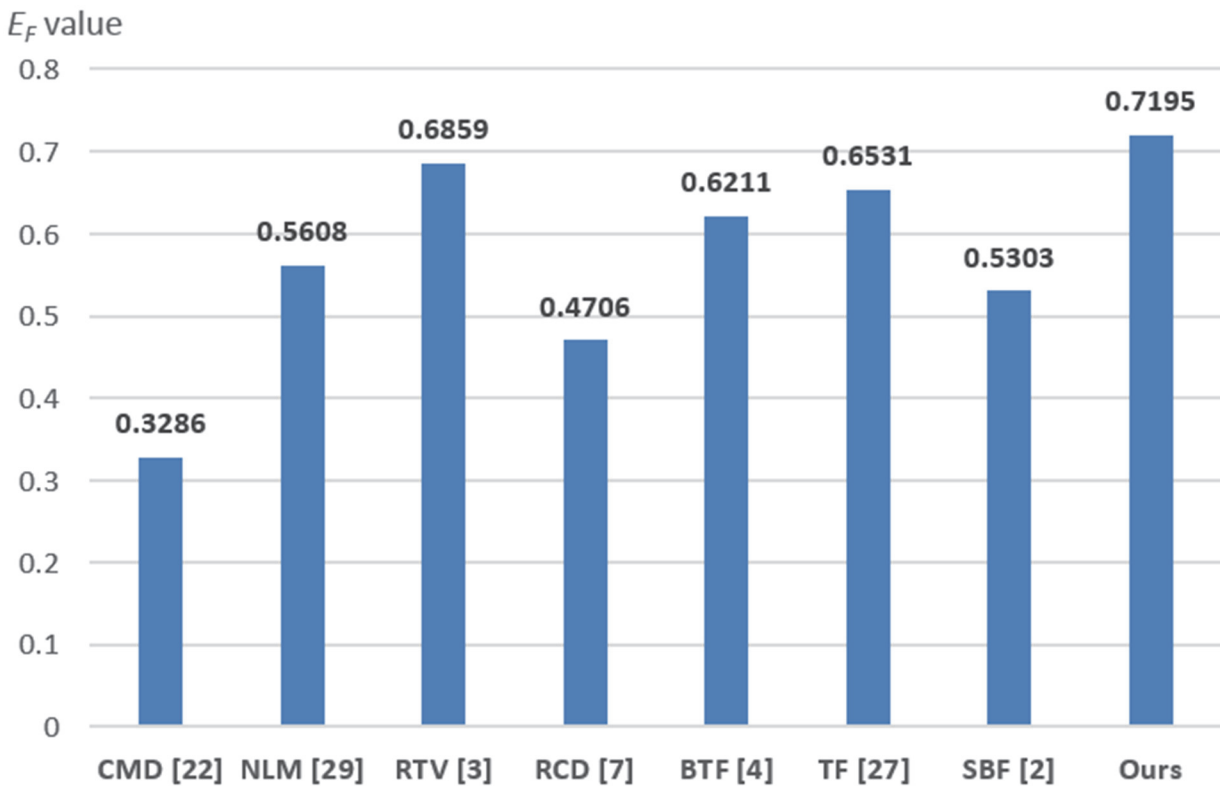
Userstudy_4

(The materials for quantization evaluation of images with texture filtering)

The overall statistics for quantization measurement of the filtered images by the listed methods are given in the following Figure, where 40 images are used. It shows our potential to smooth out textures of multiple scales, preserve structure edges and suppress blurring effects, superior to the other methods.



[2] SBF: T.-H. Lin, D.-L. Way, Z.-C. Shih, W.-K. Tai, and C.- C. Chang, "An efficient structure-aware bilateral texture filtering for image smoothing," Comput. Graph. Forum (Proc. Pacific Graphics'2006), vol. 35, no. 7, pp. 57–66, 216.

[3] RTV: L. Xu, Q. Yan, Y. Xia, and J. Jia, "Structure extraction from texture via relative total variation," ACM Trans. Graph., vol. 31, no. 6, pp. 139:1–139:10, Nov. 2012.

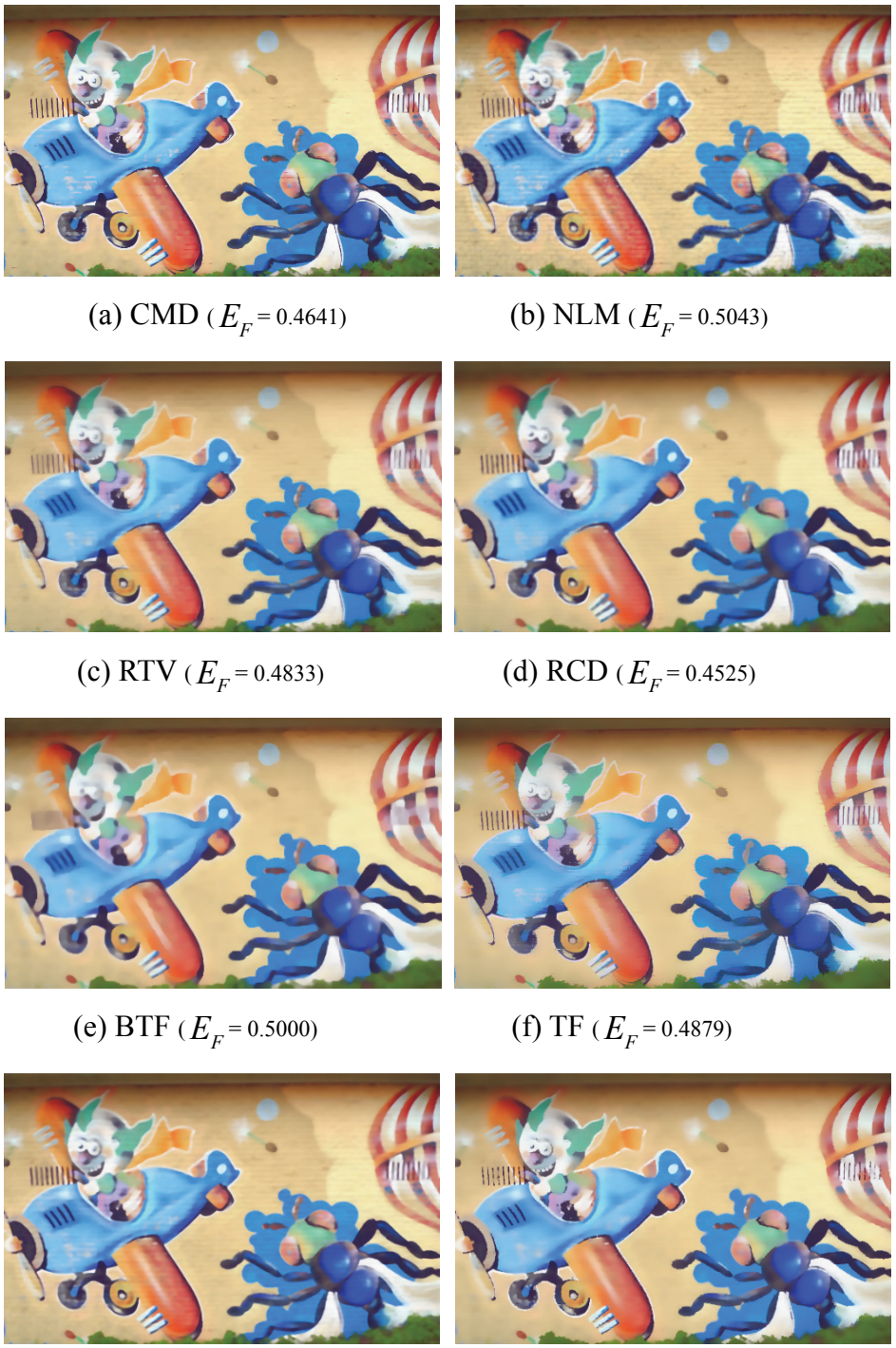
[4] BTF: H. Cho, H. Lee, H. Kang, and S. Lee, "Bilateral texture filtering," ACM Trans. Graph., vol. 33, no. 4, pp. 128:1–128:8, Jul. 2014.

[7] RCD: L. Karacan, E. Erdem, and A. Erdem, "Structurepreserving image smoothing via region covariances," ACM Transactions on Graphics, vol. 32, no. 6, pp. 176:1–176:11, Nov. 2013.

[22] CMD: G. Gilboa, N. Sochen, and Y. Y. Zeevi, "Image enhancementand denoising by complex diffusion processes," IEEE Trans. Pattern Anal. Mach. Intell., vol. 26, no. 8, pp. 1020–1036, Aug. 2004.

[27] TF: L. Bao, Y. Song, Q. Yang, H. Yuan, and G. Wang, "Tree filtering: Efficient structure-preserving smoothing with a minimum spanning tree," IEEE Trans. Image Process., vol. 23, no. 2, pp. 555–569, Feb. 2014.

[29] NLM: A. Buades, B. Coll, and J.-M. Morel, "A non-local algorithm for image denoising," in Proc. IEEE CVPR, 2005, pp. 60–65.



(a) CMD ($E_F = 0.4641$) (b) NLM ($E_F = 0.5043$)

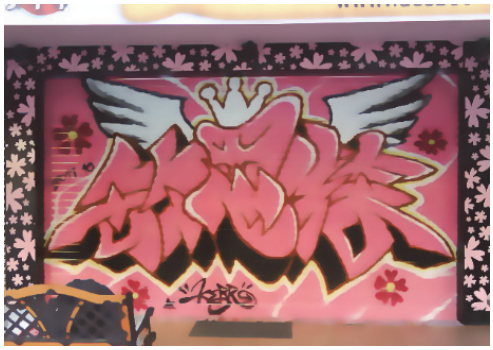
(c) RTV ($E_F = 0.4833$) (d) RCD ($E_F = 0.4525$)

(e) BTF ($E_F = 0.5000$) (f) TF ($E_F = 0.4879$)

(g) SBF ($E_F = 0.4784$) (h) Ours ($E_F = 0.4874$)

Fig.1. Their settings are: CMD(t=15, n_{itr}=3); NLM(p=2, k=4, σ=0.15, n_{itr}=3); RTV(λ=0.015, σ=4); RCD(k=13, σ=0.3, Model1); BTF(k=11,n_{itr}=4); TF(σ=0.02, σ_s=6); SBF(k=11, n_{itr}=4); Ours(k=13,c=3, n_{itr} =4).

(a) CMD (E_F = 0.4509)

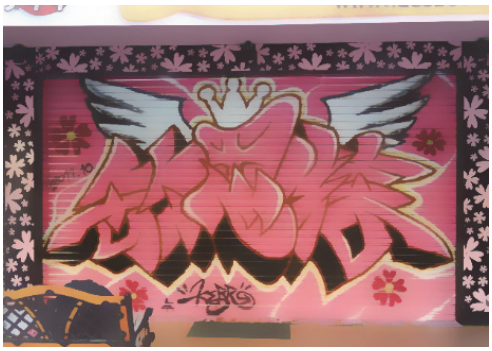


(b) NLM (E_F = 0.7987)

(c) RTV (E_F = 0.6597)

(d) RCD (E_F = 0.4784)

(e) BTF (E_F = 0.8051)



(f) TF (E_F = 0.50000)

(g) SBF (E_F = 0.5000)

(h) Ours (E_F = 0.7948)

Fig.2. CMD(t=15, n_{itr}=3); NLM(p=2, k=4, σ=0.15, n_{itr}=3); RTV(λ=0.02, σ=3); RCD(k=11, σ=0.35, Model2); BTF(k=7, n_{itr}=4); TF(σ=0.015, σ_s=6); SBF(k=11, n_{itr}=4); Ours(k=13,c=5, n_{itr}=4).

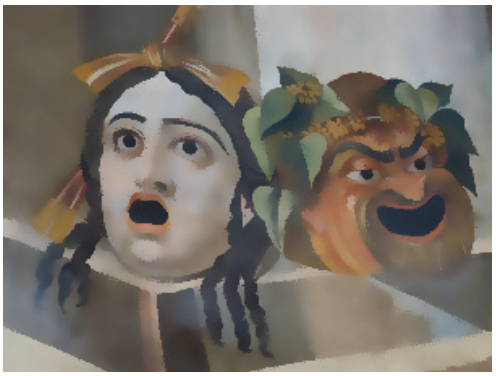
(a) CMD ($E_F = 0.1617$)

(b) NLM ($E_F = 0.5000$)

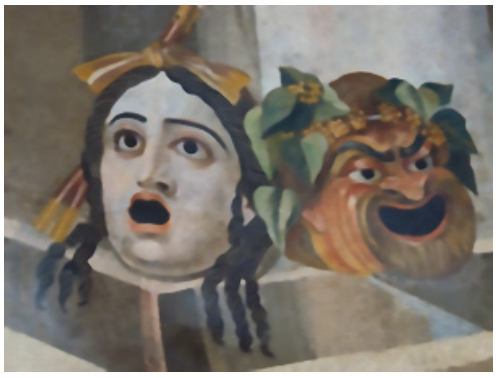
(c) RTV ($E_F = 0.4312$)

(d) RCD ($E_F = 0.4092$)

(e) BTF ($E_F = 0.5000$)



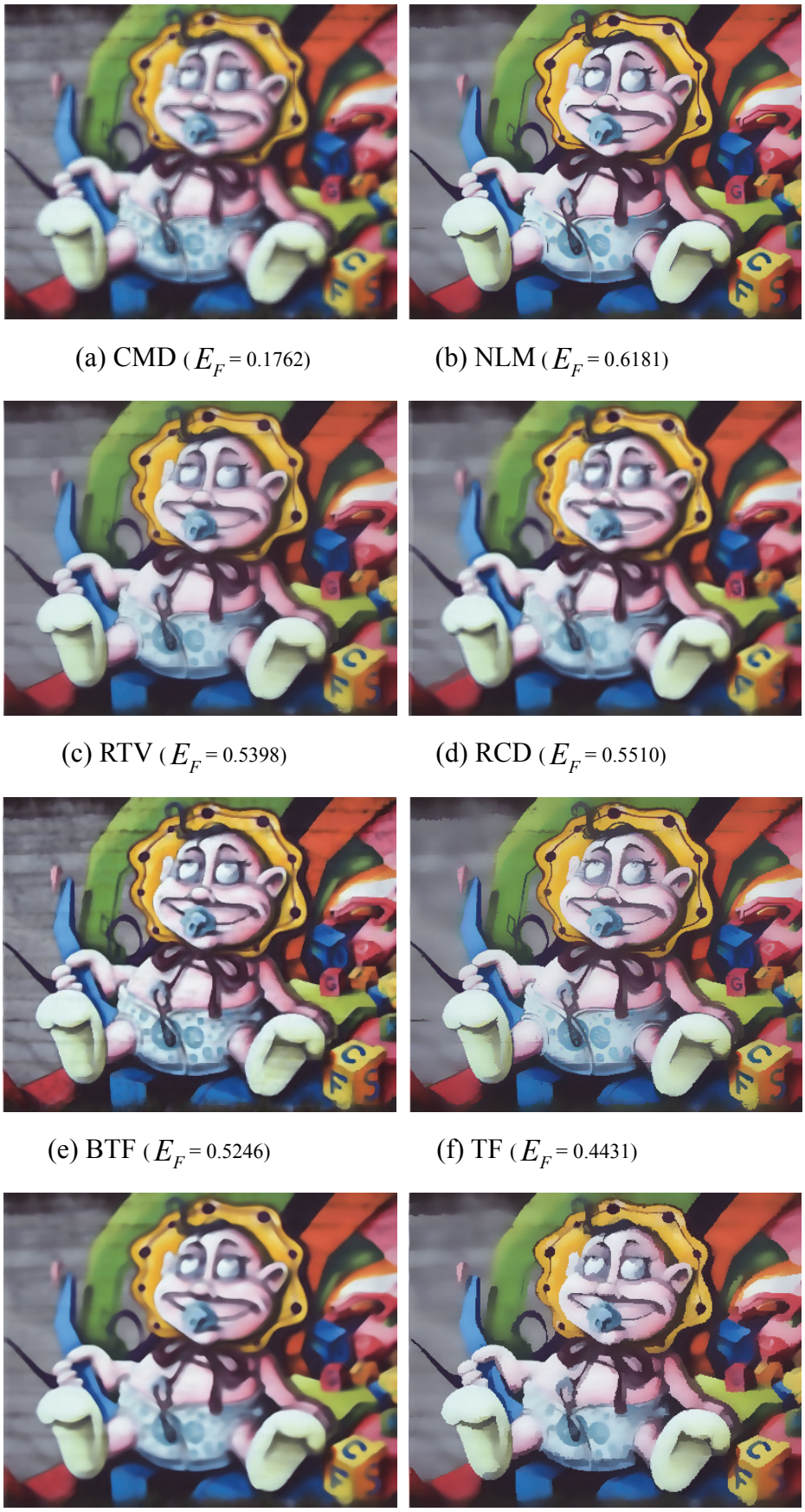
(f) TF ($E_F = 0.6183$)



(g) SBF ($E_F = 0.5091$)

(h) Ours ($E_F = 0.7576$)

Fig.3. CMD(t=15, n_{itr}=5); NLM(p=3, k=5, σ=0.35, n_{itr}=5); RTV(λ=0.02, σ=5); RCD(k=9, σ=0.3, Model1); BTF(k=7, n_{itr}=3); TF(σ=0.02, σ_s=5); SBF(k=11, n_{itr}=5); Ours(k=11,c=3, n_{itr}=3).



(a) CMD ($E_F = 0.1762$) (b) NLM ($E_F = 0.6181$)

(c) RTV ($E_F = 0.5398$) (d) RCD ($E_F = 0.5510$)

(e) BTF ($E_F = 0.5246$) (f) TF ($E_F = 0.4431$)

(g) SBF ($E_F = 0.7040$) (h) Ours ($E_F = 0.6406$)

Fig.4. CMD(t=15, n_{itr}=3); NLM(p=2, k=4, σ=0.15, n_{itr}=3); RTV(λ=0.015, σ=3); RCD(k=9, σ=0.15, Model1); BTF(k=5, n_{itr}=2); TF(σ=0.025, σ_s=5); SBF(k=7, n_{itr}=2); Ours(k=11,c=3, n_{itr} =2).

(a) CMD ($E_F = 0.3290$)　　(b) NLM ($E_F = 0.5475$)

(c) RTV ($E_F = 0.4455$)　　(d) RCD ($E_F = 0.5880$)　　(e) BTF ($E_F = 0.4984$)

(f) TF ($E_F = 0.5000$)　　(g) SBF ($E_F = 0.5000$)　　(h) Ours ($E_F = 0.7423$)

Fig.5. CMD(t=15, n_{itr}=3); NLM(p=3, k=5, σ=0.2, n_{itr}=4); RTV(λ=0.02, σ=6); RCD(k=13, σ=0.4, Model2); BTF(k=9, n_{itr}=4); TF(σ=0.025, σ_s=6); SBF(k=11, n_{itr}=4); Ours(k=9,c=3, n_{itr}=4).

(a) CMD ($E_F = 0.3471$) (b) NLM ($E_F = 0.5497$)

(c) RTV ($E_F = 0.4325$) (d) RCD ($E_F = 0.5040$) (e) BTF ($E_F = 0.4208$)

(f) TF ($E_F = 0.6306$) (g) SBF ($E_F = 0.5818$) (h) Ours ($E_F = 0.5385$)

Fig.6. CMD(t=15, n_{itr}=3); NLM(p=2, k=4, σ=0.2, n_{itr}=3); RTV(λ=0.025, σ=6); RCD(k=11, σ=0.2, Model2); BTF(k=9, n_{itr}=3); TF(σ=0.02, σ_s=5); SBF(k=9, n_{itr}=3); Ours(k=13,c=3, n_{itr} =3).

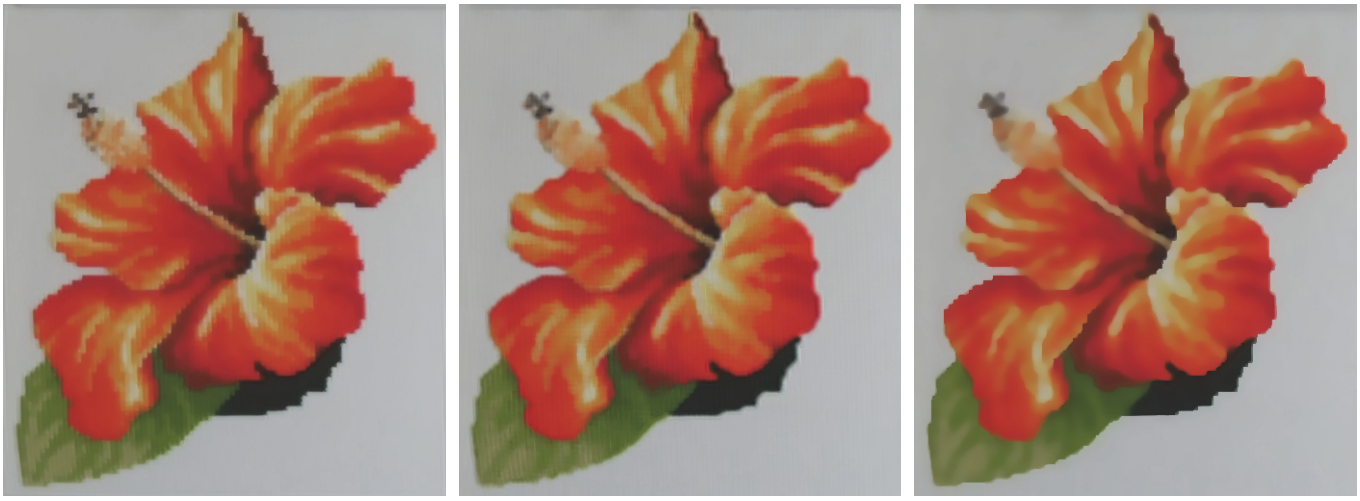
(a) CMD ($E_F = 0.0816$) (b) NLM ($E_F = 0.7533$)

(c) RTV ($E_F = 0.5015$) (d) RCD ($E_F = 0.3993$) (e) BTF ($E_F = 0.5000$)

(f) TF ($E_F = 0.8276$) (g) SBF ($E_F = 0.5474$) (h) Ours ($E_F = 0.7832$)

Fig.7. CMD(t=15, n_{itr}=3); NLM(p=5, k=5, σ=0.2, n_{itr}=3); RTV(λ=0.025, σ=6); RCD(k=11, σ=0.2, Model2); BTF(k=9, n_{itr}=3); TF(σ=0.02, σ_s=5); SBF(k=11, n_{itr}=3); Ours(k=13,c=3, n_{itr}=3).

(a) CMD ($E_F = 0.3735$) (b) NLM ($E_F = 0.4137$)



(c) RTV ($E_F = 0.7214$) (d) RCD ($E_F = 0.6012$) (e) BTF($E_F = 0.7870$)

(f) TF ($E_F = 0.4857$) (g) SBF ($E_F = 0.7452$) (h) Ours ($E_F = 0.8620$)

Fig.8. CMD(t=15, n_{itr}=3); NLM(p=5, k=5, σ=0.2, n_{itr}=3); RTV(λ=0.015, σ=3); RCD(k=9, σ=0.15, Model2); BTF(k=7, n_{itr}=2); TF(σ=0.02, σ_s=3); SBF(k=7, n_{itr}=2); Ours(k=9,c=3, n_{itr}=2).

(a) CMD ($E_F = 0.3333$) (b) NLM ($E_F = 0.5289$)

(c) RTV ($E_F = 0.5562$) (d) RCD ($E_F = 0.2937$) (e) BTF ($E_F = 0.8039$)

(f) TF ($E_F = 0.5786$) (g) SBF ($E_F = 0.5000$) (h) Ours ($E_F = 0.8345$)

Fig.9. CMD(t=15, n_{itr}=3); NLM(p=5, k=5, σ=0.2, n_{itr}=3); RTV(λ =0.03, σ =5); RCD(k=11, σ =0.2, Model1); BTF(k=7, n_{itr}=3); TF(σ =0.03, σ_s =4); SBF(k=9, n_{itr}=3); Ours(k=11,c=3, n_{itr}=3).

(a) CMD

($E_F = 0.0217$)

(b) NLM

($E_F = 0.7754$)

(c) RTV

($E_F = 0.8565$)

(d) RCD

($E_F = 0.4306$)

(e) BTF

($E_F = 0.6322$)

(f) TF

($E_F = 0.7337$)

(g) SBF

($E_F = 0.6437$)

(h) Ours

($E_F = 0.7519$)

Fig.10. CMD(t=15, n_{itr}=3); NLM(p=3, k=5, σ=0.2, n_{itr}=3); RTV(λ=0.01, σ=6); RCD(k=13, σ=0.2, Model1); BTF(k=5, n_{itr}=3); TF(σ=0.015, σ_s=3); SBF(k=7, n_{itr}=4); Ours(k=9,c=3, n_{itr}=3).

(a) CMD (E_F = 0.0358)

(b) NLM (E_F = 0.7554)

(c) RTV (E_F = 0.7844)

(d) RCD (E_F = 0.5216)

(e) BTF (E_F = 0.8612)

(f) TF (E_F = 0.7489)

(g) SBF (E_F = 0.5578)

(h) Ours (E_F = 0.8927)

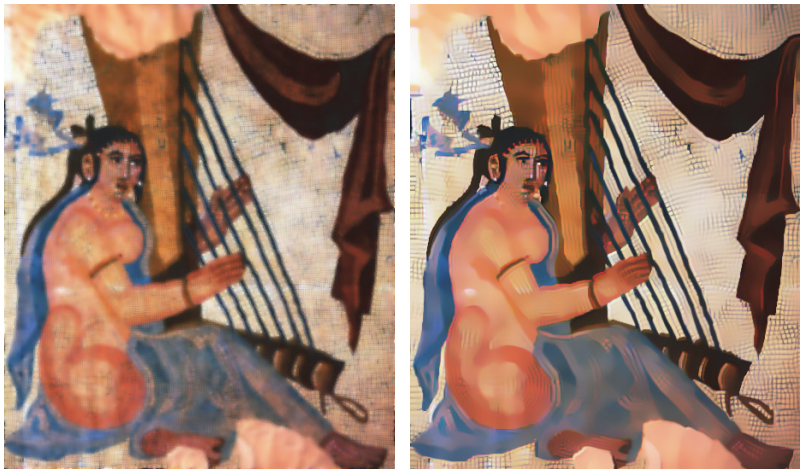
Fig.11. CMD(t=15, n_{itr}=4); NLM(p=5, k=5, σ=0.2, n_{itr}=5); RTV(λ=0.02, σ=5); RCD(k=13, σ=0.2, Model1); BTF(k=11,n_{itr}=5); TF(σ=0.02, σ_s=5); SBF(k=11, n_{itr}=5); Ours(k=11,c=3, n_{itr}=5).

(a) CMD (E_F = 0.0688)　　(b) NLM (E_F = 0.5224)

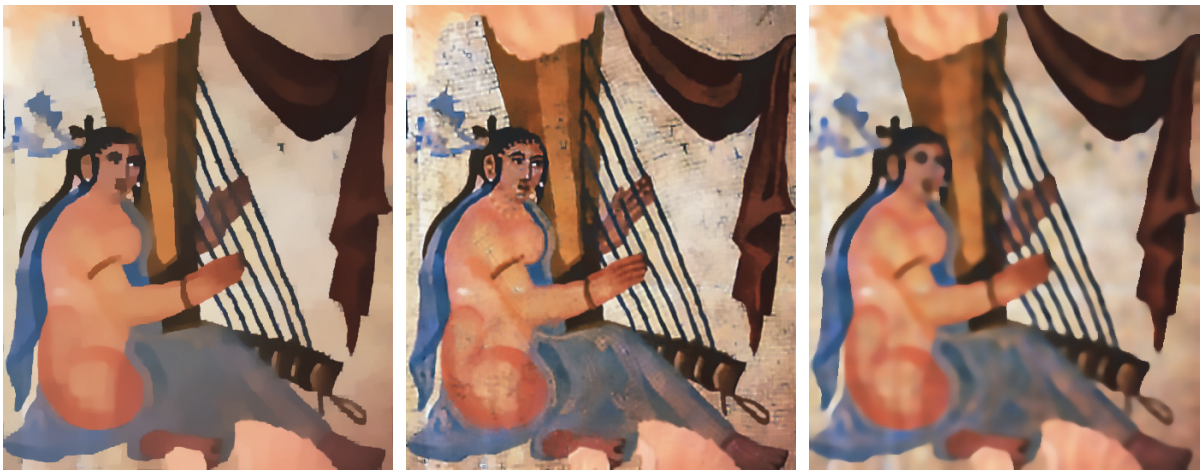
(c) RTV (E_F = 0.4719)　　(d) RCD (E_F = 0.4122)　　(e) BTF (E_F = 0.7417)

(f) TF (E_F = 0.7689)　　(g) SBF (E_F = 0.5513)　　(h) Ours (E_F = 0.8064)

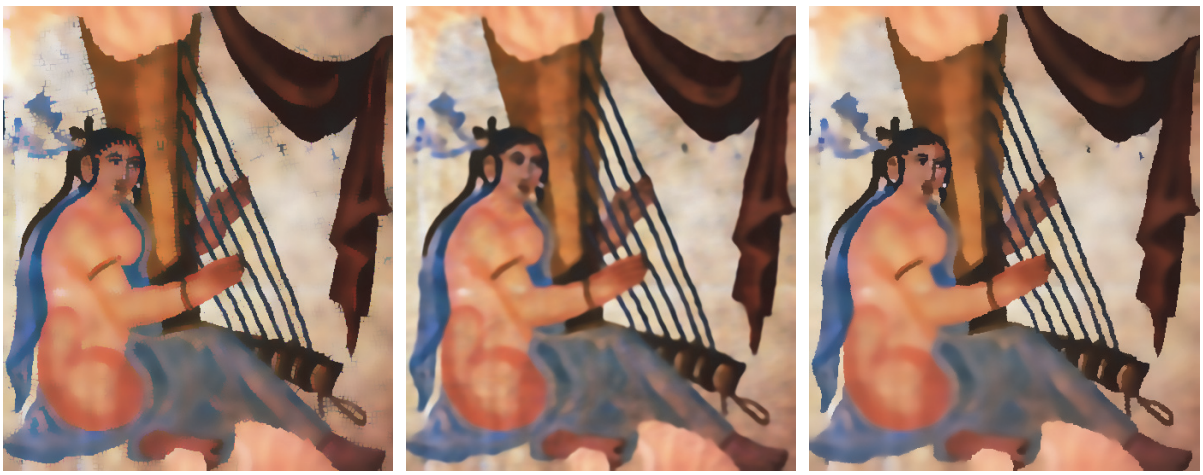
Fig.12. CMD(t=15, n_{itr}=4); NLM(p=3, k=7, σ=0.15, n_{itr}=4); RTV(λ=0.015, σ=4); RCD(k=9, σ=0.2, Model1); BTF(k=7, n_{itr}=4); TF(σ=0.03, σ_s=4); SBF(k=7, n_{itr}=4); Ours(k=7,c=3, n_{itr}=4).



(a) CMD (E_F = 0.2011)　　(b) NLM (E_F = 0.5000)



(c) RTV (E_F = 0.8759)　　(d) RCD (E_F = 0.6643)　　(e) BTF (E_F = 0.5000)



(f) TF (E_F = 0.7498)　　(g) SBF (E_F = 0.5412)　　(h) Ours (E_F = 0.7365)

Fig.13. CMD(t=15, n_{itr}=3); NLM(p=5, k=7, σ=0.2, n_{itr}=3); RTV(λ=0.015, σ=4); RCD(k=11, σ=0.2, Model1); BTF(k=9, n_{itr}=3); TF(σ=0.015, σ_s=3); SBF(k=7, n_{itr}=3); Ours(k=11,c=3, n_{itr}=3).

(a) CMD (E_F = 0.4377) (b) NLM (E_F = 0.5000)

(c) RTV (E_F = 0.5450) (d) RCD (E_F = 0.4923) (e) BTF(E_F = 0.5970)

(f) TF (E_F = 0.6307) (g) SBF (E_F = 0.4969) (h) Ours (E_F = 0.7086)

Fig.14. CMD(t=15, n_{itr}=3); NLM(p=3, k=5, σ=0.18, n_{itr}=3); RTV(λ =0.02, σ=7); RCD(k=9, σ=1.0, Model2); BTF(k=11, n_{itr}=2); TF(σ=0.015, σ_s =6); SBF(k=9, n_{itr}=2); Ours(k=15,c=3, n_{itr}=2).

(a) CMD (E_F = 0.5000) (b) NLM (E_F = 0.6161)

(c) RTV (E_F = 0.8283) (d) RCD (E_F = 0.6081) (e) BTF(E_F = 0.7537)

(f) TF (E_F = 0.4971) (g) SBF (E_F = 0.5000) (h) Ours (E_F = 0.7613)

Fig.15. CMD(t=25, n_{itr}=5); NLM(p=5, k=5, σ=0.2 , n_{itr}=5); RTV(λ =0.015, σ=6); RCD(k=19, σ=0.2, Model1); BTF(k=15, n_{itr}=5); TF(σ=0.015, σ_s=6); SBF(k=11, n_{itr}=5); Ours(k=15,c=3, n_{itr}=5).

(a) CMD ($E_F = 0.2632$) (b) NLM ($E_F = 0.7869$)

(c) RTV ($E_F = 0.9626$) (d) RCD ($E_F = 0.4326$) (e) BTF ($E_F = 0.7022$)

(f) TF ($E_F = 0.8294$) (g) SBF($E_F = 0.6549$) (h) Ours ($E_F = 0.7988$)

Fig.16. CMD(t=15, n_{itr}=2); NLM(p=3, k=5, σ=0.15 , n_{itr}=3); RTV(λ =0.015, σ =2); RCD(k=9, σ =0.25, Model1); BTF(k=5, n_{itr}=3); TF(σ =0.015, σ_s=3); SBF(k=7, n_{itr}=2); Ours(k=13,c=3, n_{itr}=3).

(a) CMD ($E_F = 0.1615$)　　(b) NLM ($E_F = 0.0000$)

(c) RTV ($E_F = 0.8671$)　　(d) RCD ($E_F = 0.5485$)　　(e) BTF ($E_F = 0.5857$)

(f) TF ($E_F = 0.4773$)　　(g) SBF ($E_F = 0.5513$)　　(h) Ours ($E_F = 0.9810$)

Fig.17. CMD(t=20, n_{itr}=4); NLM(p=5, k=7, σ=0.25, n_{itr}=4); RTV(λ =0.01, σ=4); RCD(k=9, σ=0.25, Model1); BTF(k=7, n_{itr}=4); TF(σ=0.02, σ_s=4); SBF(k=7, n_{itr}=4); Ours(k=11,c=3, n_{itr}=4).

(a) CMD (E_F = 0.0744)　　(b) NLM (E_F = 0.5912)

(c) RTV (E_F = 0.6882)　　(d) RCD (E_F = 0.3296)

(e) BTF (E_F = 0.5514)　　(f) TF (E_F = 0.7428)

(g) SBF (E_F = 0.4474)　　(h) Ours (E_F =0.8397)

Fig.18. CMD(t=25, n_{itr}=3); NLM(p=5, k=5, σ=0.25 , n_{itr}=3); RTV(λ =0.015, σ=6); RCD(k=11, σ=0.3, Model1); BTF(k=9, n_{itr}=3); TF(σ=0.02, σ_s=4); SBF(k=9, n_{itr}=5); Ours(k=15,c=3, n_{itr} =3).

(a) CMD (E_F = 0.2503)

(b) NLM (E_F = 0.5000)

(c) RTV (E_F = 0.7177)

(d) RCD (E_F = 0.3503)

(e) BTF (E_F = 0.5034)

(f) TF (E_F = 0.7980)

(g) SBF (E_F = 0.4054)

(h) Ours (E_F = 0.5000)

Fig.19. CMD(t=15, n_{itr}=3); NLM(p=3, k=5, σ=0.25, n_{itr}=4); RTV(λ =0.005, σ =4); RCD(k=11, σ =0.3, Model1); BTF(k=9, n_{itr}=4); TF(σ =0.01, σ_s =3); SBF(k=11, n_{itr}=1); Ours(k=11,c=3, n_{itr}=1).

(a) CMD ($E_F = 0.2642$) (b) NLM ($E_F = 0.6206$)

(c) RTV($E_F = 0.6957$) (d) RCD ($E_F = 0.3394$) (e) BTF($E_F = 0.6613$)

(f) TF ($E_F = 0.50000$) (g) SBF ($E_F = 0.5590$) (h) Ours ($E_F = 0.6814$)

Fig.20. CMD(t=25, n_{itr}=5); NLM(p=5, k=7, σ=0.25 , n_{itr}=5); RTV(λ =0.015, σ=4); RCD(k=19, σ =0.3, Model1); BTF(k=11, n_{itr}=4); TF(σ =0.03, σ_s=4); SBF(k=11, n_{itr}=4); Ours(k=19,c=3, n_{itr}=6).

(a) CMD ($E_F = 0.3963$)

(b) NLM ($E_F = 0.4887$)

(c) RTV ($E_F = 0.5907$)

(d) RCD ($E_F = 0.5280$)

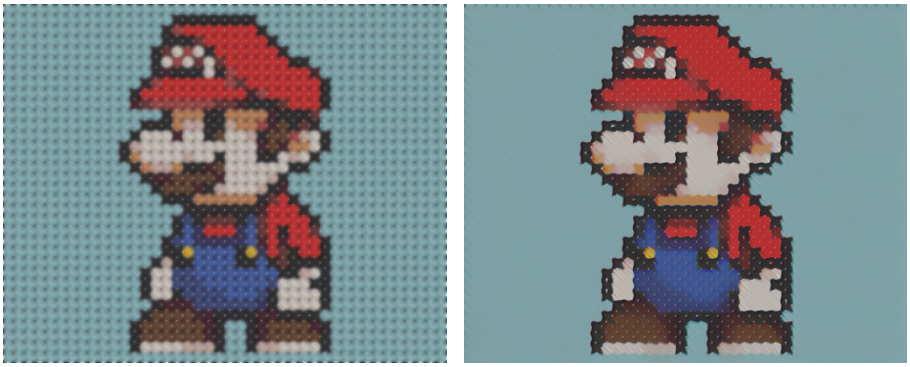
(e) BTF ($E_F = 0.5541$)

(f) TF ($E_F = 0.7650$)

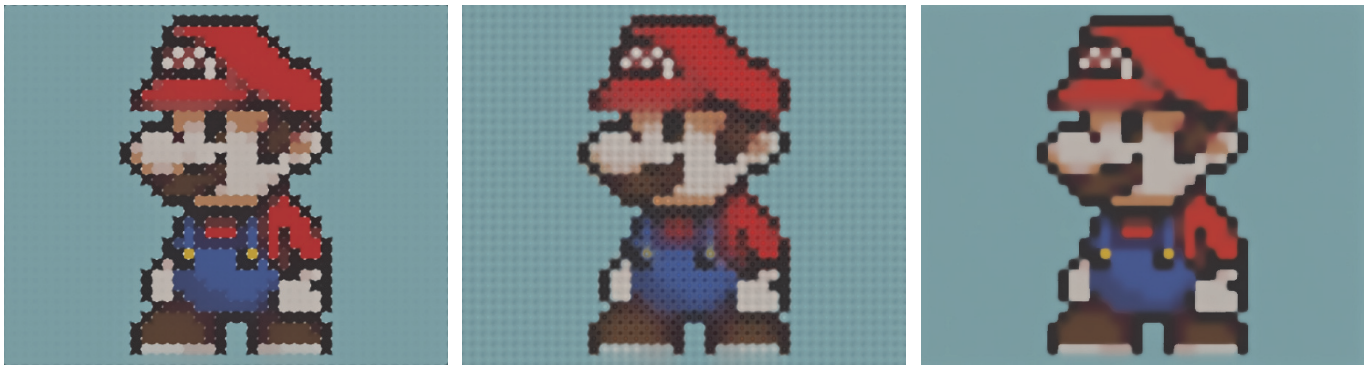
(g) SBF ($E_F = 0.5000$)

(h) Ours ($E_F = 0.6221$)

Fig.21. CMD(t=25, n_{itr}=3); NLM(p=5, k=5, σ=0.25 , n_{itr}=3); RTV(λ =0.015, σ=4); RCD(k=17, σ=0.35, Model1); BTF(k=9, n_{itr}=4); TF(σ=0.015, σ_s=4); SBF(k=13, n_{itr}=3); Ours(k=15,c=3, n_{itr} =3).



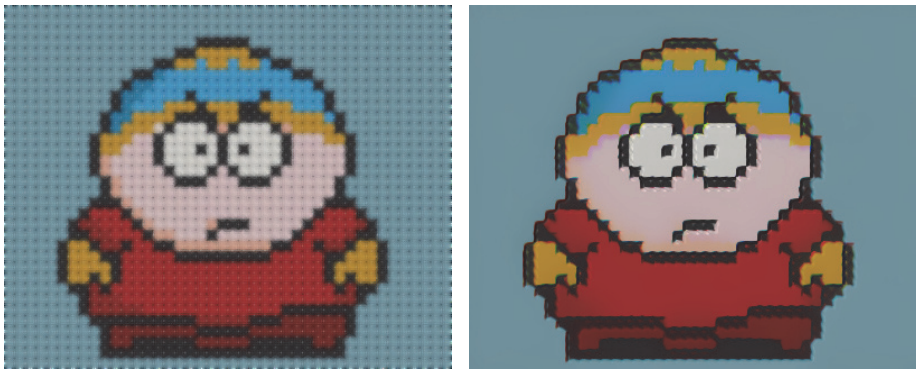
(a) CMD ($E_F = 0.2345$) (b) NLM ($E_F = 0.6663$)



(c) RTV ($E_F = 0.9455$) (d) RCD ($E_F = 0.4851$) (e) BTF($E_F = 0.6045$)

(f) TF ($E_F = 0.8656$) (g) SBF ($E_F = 0.4951$) (h) Ours ($E_F = 0.7161$)

Fig.22. CMD(t=15, n_{itr}=4); NLM(p=5, k=9, σ=0.25, n_{itr}=3); RTV(λ =0.015, σ=4); RCD(k=19, σ =0.35, Model1); BTF(k=11, n_{itr}=4); TF(σ =0.015, σ_s=4); SBF(k=11, n_{itr}=4); Ours(k=15, c=3, n_{itr}=4).



(a) CMD ($E_F = 0.5000$) (b) NLM ($E_F = 0.5253$)

(c) RTV($E_F = 0.7955$) (d) RCD ($E_F = 0.3040$) (e) BTF($E_F = 0.6507$)

(f) TF ($E_F = 0.5000$) (g) SBF ($E_F = 0.4683$) (h) Ours ($E_F = 0.7120$)

Fig.23. CMD(t=15, n_{itr}=3); NLM(p=5, k=9, σ=0.25, n_{itr}=3); RTV(λ =0.015, σ=4); RCD(k=19, σ =0.35, Model1); BTF(k=9, n_{itr}=3); TF(σ =0.015, σ_s=4); SBF(k=9, n_{itr}=3); Ours(k=15, c=3, n_{itr}=3).

(a) CMD ($E_F = 0.4115$) (b) NLM ($E_F = 0.5000$)

(c) RTV($E_F = 0.7278$) (d) RCD ($E_F = 0.5000$) (e) BTF($E_F = 0.7537$)

(f) TF ($E_F = 0.7495$) (g) SBF ($E_F = 0.5613$) (h) Ours ($E_F = 0.7848$)

Fig.24. CMD(t=15, n_{itr}=3); NLM(p=5, k=9, σ=0.25, n_{itr}=3); RTV(λ =0.015, σ=4); RCD(k=17, σ =0.4, Model1); BTF(k=11, n_{itr}=3); TF(σ =0.01, σ_s=4); SBF(k=9, n_{itr}=3); Ours(k=11, c=3, n_{itr}=3).

(a) CMD ($E_F = 0.2525$) (b) NLM ($E_F = 0.5000$)

(c) RTV($E_F = 0.5108$) (d) RCD ($E_F = 0.4458$) (e) BTF($E_F = 0.5665$)

(f) TF ($E_F = 0.6895$) (g) SBF ($E_F = 0.4385$) (h) Ours ($E_F = 0.7970$)

Fig.25. CMD(t=25, n_{itr}=2); NLM(p=5, k=5, σ=0.15 , n_{itr}=2); RTV(λ =0.015, σ=4); RCD(k=15, σ =0.2, Model1); BTF(k=7, n_{itr}=2); TF(σ=0.01, σ_s=4); SBF(k=9, n_{itr}=2); Ours(k=15, c=3, n_{itr}=2).

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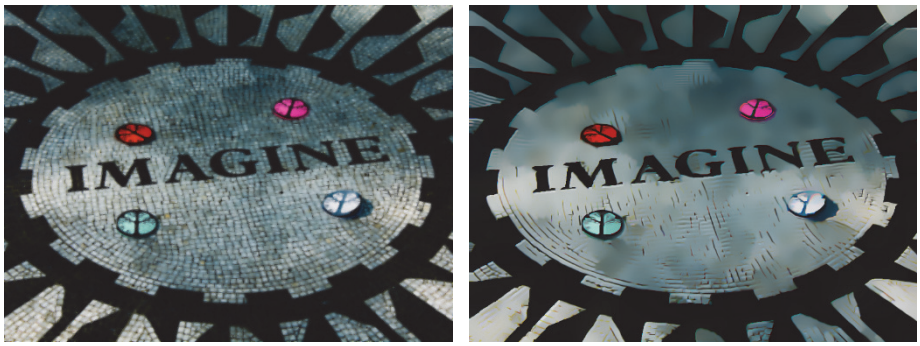


(a) CMD ($E_F = 0.3438$) (b) NLM ($E_F = 0.6269$)

(c) RTV($E_F = 0.9454$) (d) RCD ($E_F = 0.4478$) (e) BTF($E_F = 0.7944$)

(f) TF ($E_F = 0.7330$) (g) SBF ($E_F = 0.5000$) (h) Ours ($E_F = 0.7687$)

Fig.26. CMD(t=25, n_{itr}=5); NLM(p=5, k=9, σ=0.25 , n_{itr}=5); RTV(λ =0.02, σ=4); RCD(k=17, σ=1.0, Model2); BTF(k=9, n_{itr}=5); TF(σ=0.025, σ_s=6); SBF(k=11, n_{itr}=3); Ours(k=15, c=3, n_{itr}=5).

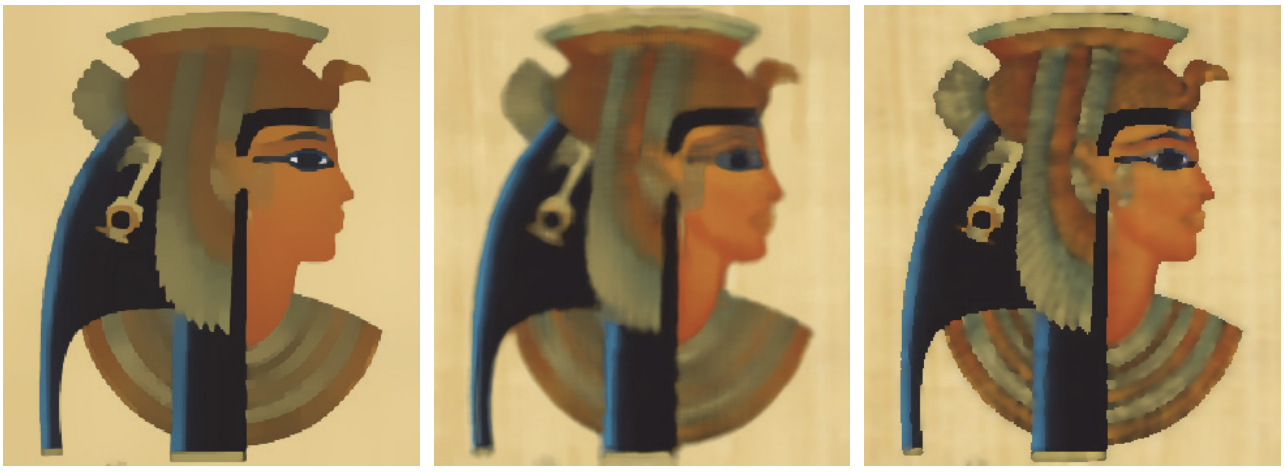
(a) CMD (E_F = 0.3300)　　(b) NLM (E_F = 0.4511)

(c) RTV(E_F = 0.6015)　　(d) RCD (E_F = 0.2654)　　(e) BTF(E_F =0.5000)

(f) TF (E_F =0.4356)　　(g) SBF (E_F =0.6694)　　(h) Ours (E_F = 0.8054)

Fig.27. CMD(t=25, n_{itr}=4); NLM(p=5, k=7, σ=0.25 , n_{itr}=4); RTV(λ =0.02, σ =4); RCD(k=19, σ =0.25, Model1); BTF(k=9, n_{itr}=4); TF(σ =0.05, σ_s =6); SBF(k=9, n_{itr}=4); Ours(k=15, c=5, n_{itr}=4).

(a) CMD ($E_F = 0.4820$)　　(b) NLM ($E_F = 0.5000$)



(c) RTV ($E_F = 0.7245$)　　(d) RCD ($E_F = 0.4921$)　　(e) BTF ($E_F = 0.6690$)

(f) TF ($E_F = 0.6916$)　　(g) SBF ($E_F = 0.5796$)　　(h) Ours ($E_F = 0.6821$)

Fig.28. CMD(t=10, n_{itr}=3); NLM(p=3, k=5, σ=0.15, n_{itr}=2); RTV(λ =0.015, σ=3); RCD(k=11, σ =1.0, Model2); BTF(k=5, n_{itr}=3); TF(σ=0.01, σ_s=4); SBF(k=7, n_{itr}=2); Ours(k=11,c=3, n_{itr}=2).

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(a) CMD (E_F = 0.4106)　　(b) NLM (E_F = 0.6302)

(c) RTV(E_F = 0.7745)　　(d) RCD (E_F = 0.4203)　　(e) BTF(E_F = 0.4978)

(f) TF (E_F = 0.6811)　　(g) SBF (E_F = 0.5097)　　(h) Ours (E_F = 0.6602)

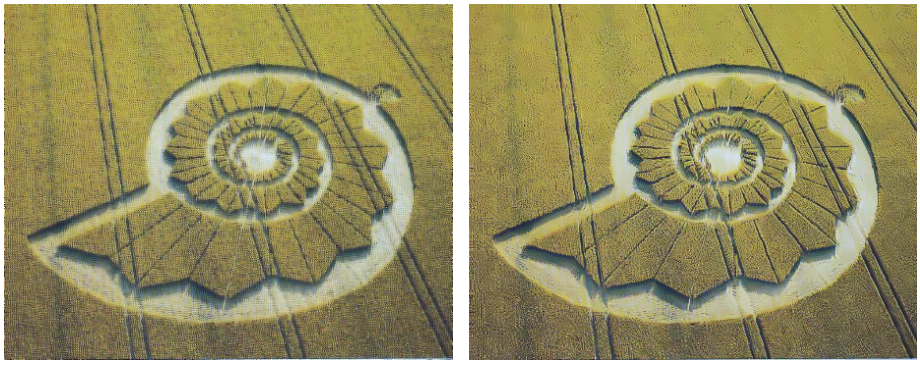
Fig.29. CMD(t=10, n_{itr}=3); NLM(p=5, k=5, σ=0.15 , n_{itr}=2); RTV(λ =0.01, σ=2); RCD(k=15, σ=1.0, Model2); BTF(k=7, n_{itr}=2); TF(σ=0.01, σ_s=4); SBF(k=7, n_{itr}=2); Ours(k=11, c=3, n_{itr}=2).

(a) CMD ($E_F = 0.4679$) (b) NLM ($E_F = 0.5390$)

(c) RTV($E_F = 0.6227$) (d) RCD ($E_F = 0.5000$) (e) BTF($E_F = 0.5869$)

(f) TF ($E_F = 0.5896$) (g) SBF ($E_F = 0.4941$) (h) Ours ($E_F = 0.6057$)

Fig.30. CMD(t=10, n_{itr}=2); NLM(p=5, k=5, σ=0.15, n_{itr}=2); RTV(λ =0.015, σ=3); RCD(k=15, σ =0.25, Model1); BTF(k=7, n_{itr}=2); TF(σ =0.015, σ_s=4); SBF(k=7, n_{itr}=3); Ours(k=11, c=3, n_{itr}=2).



(a) CMD ($E_F = 0.4113$) (b) NLM ($E_F = 0.5000$)

(c) RTV($E_F = 0.7677$) (d) RCD ($E_F = 0.5000$) (e) BTF($E_F = 0.6258$)

(f) TF ($E_F = 0.6699$) (g) SBF ($E_F = 0.5258$) (h) Ours ($E_F = 0.6595$)

Fig.31 CMD(t=10, n_{itr}=2); NLM(p=5, k=5, σ=0.15, n_{itr}=2); RTV(λ =0.01, σ=2); RCD(k=15, σ=0.25, Model1); BTF(k=5, n_{itr}=2); TF(σ=0.005, σ_s=3); SBF(k=7, n_{itr}=2); Ours(k=15, c=3, n_{itr}=2).

(a) CMD ($E_F = 0.5000$) (b) NLM ($E_F = 0.6272$)

(c) RTV($E_F = 0.7139$) (d) RCD ($E_F = 0.4767$) (e) BTF($E_F = 0.6131$)

(f) TF($E_F = 0.6903$) (g) SBF ($E_F = 0.3732$) (h) Ours ($E_F = 0.8083$)

Fig.32. CMD(t=15, n_{itr}=4); NLM(p=5, k=9, σ=0.25, n_{itr}=3); RTV(λ =0.02, σ=3); RCD(k=17, σ=0.35, Model1); BTF(k=7, n_{itr}=4); TF(σ=0.015, σ_s=4); SBF(k=7, n_{itr}=3); Ours(k=15, c=3, n_{itr}=3).

(a) CMD ($E_F = 0.3629$) (b) NLM ($E_F = 0.8000$)

(c) RTV($E_F = 0.6862$) (d) RCD ($E_F = 0.6097$) (e) BTF($E_F = 0.6269$)

(f) TF($E_F = 0.7336$) (g) SBF ($E_F = 0.5000$) (h) Ours ($E_F = 0.7301$)

Fig.33. CMD(t=15, n_{itr}=4); NLM(p=3, k=5, σ=0.15, n_{itr}=3); RTV(λ =0.01, σ=3); RCD(k=19, σ=0.4, Model1); BTF(k=7, n_{itr}=3); TF(σ=0.015, σ_s=3); SBF(k=9, n_{itr}=3); Ours(k=11, c=3, n_{itr}=3).

(a) CMD ($E_F = 0.5000$)

(b) NLM ($E_F = 0.6596$)

(c) RTV ($E_F = 0.7227$)

(d) RCD ($E_F = 0.4896$)

(e) BTF ($E_F = 0.5326$)

(f) TF ($E_F = 0.7125$)

(g) SBF ($E_F = 0.5221$)

(h) Ours ($E_F = 0.7445$)

Fig.34. CMD(t=15, n_{itr}=4); NLM(p=5, k=9, σ=0.25, n_{itr}=3); RTV(λ=0.01, σ=3); RCD(k=19, σ=0.3, Model1); BTF(k=7, n_{itr}=3); TF(σ=0.015, σ_s=3); SBF(k=9, n_{itr}=2); Ours(k=11,c=3, n_{itr}=3).

(a) CMD (E_F = 0.4205) (b) NLM (E_F = 0.5000)

(c) RTV(E_F = 0.5086) (d) RCD (E_F = 0.5004) (e) BTF(E_F = 0.5605)

(f) TF(E_F = 0.5330) (g) SBF (E_F = 0.4301 (h) Ours (E_F = 0.5322)

Fig.35 CMD(t=15, n_{itr}=1); NLM(p=3, k=5, σ=0.15, n_{itr}=1); RTV(λ =0.01, σ=3); RCD(k=11, σ=0.25, Model1); BTF(k=5, n_{itr}=1); TF(σ=0.005, σ_s=2); SBF(k=9, n_{itr}=3); Ours(k=9, c=3, n_{itr}=1).

(a) CMD ($E_F = 0.5000$) (b) NLM ($E_F = 0.3730$)

(c) RTV($E_F = 0.2730$) (d) RCD ($E_F = 0.4247$) (e) BTF($E_F = 0.4517$)

(f) TF($E_F = 0.3218$) (g) SBF ($E_F = 0.5000$) (h) Ours ($E_F = 0.2730$)

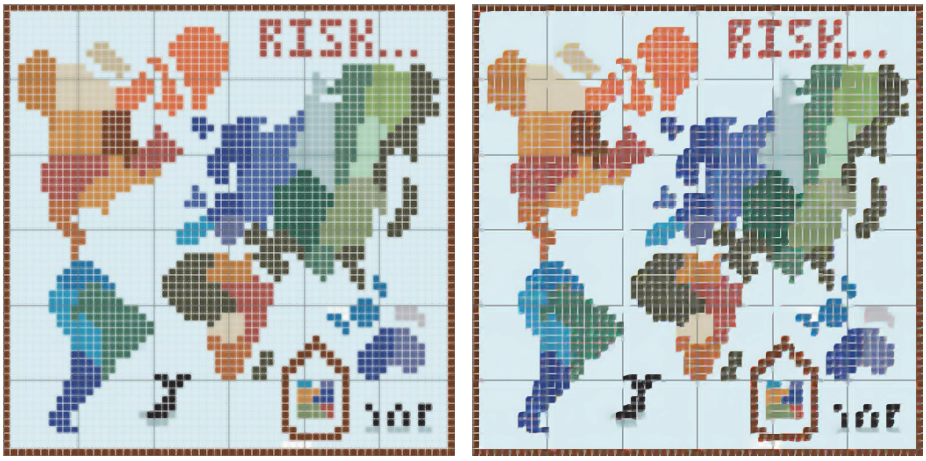
Fig.36. CMD(t=15, n_{itr}=3); NLM(p=5, k=5, σ=0.25, n_{itr}=3); RTV(λ =0.01, σ=3); RCD(k=11, σ=0.25, Model1); BTF(k=9, n_{itr}=3); TF(σ=0.015, σ_s=3); SBF(k=9, n_{itr}=3); Ours(k=11, c=3, n_{itr}=3).

(a) CMD ($E_F = 0.4000$) (b) NLM ($E_F = 0.8313$)

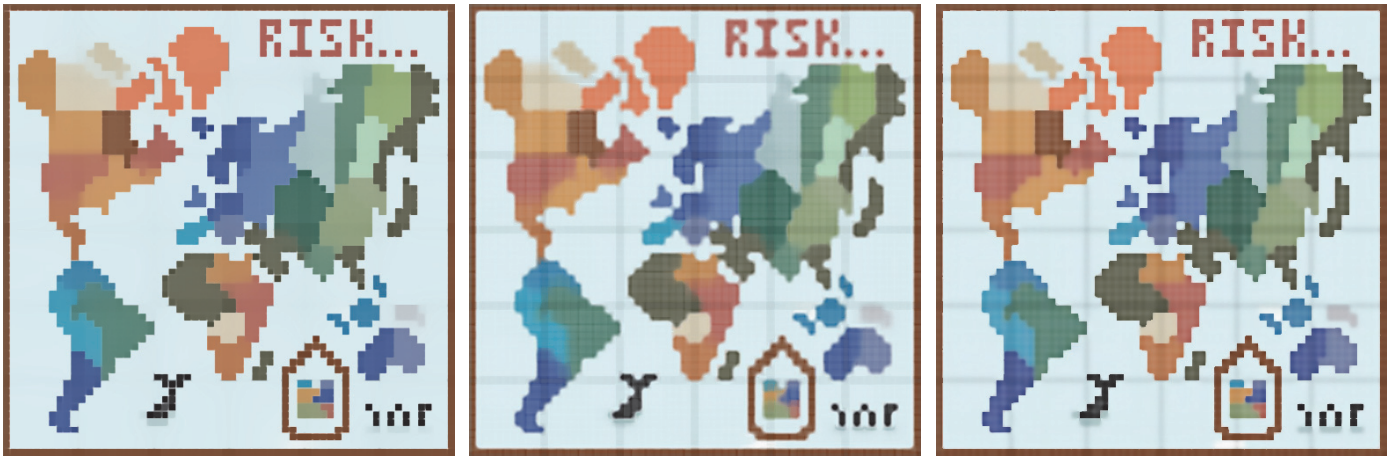
(c) RTV($E_F = 0.8000$) (d) RCD ($E_F = 0.4337$) (e) BTF($E_F = 0.7457$)

(f) TF($E_F = 0.7666$) (g) SBF ($E_F = 0.6756$) (h) Ours ($E_F = 0.7493$)

Fig.37. CMD(t=10, n_{itr}=2); NLM(p=3, k=3, σ=0.15, n_{itr}=2); RTV(λ =0.01, σ=2); RCD(k=9, σ=0.25, Model1); BTF(k=5, n_{itr}=2); TF(σ=0.01, σ_s=2); SBF(k=5, n_{itr}=2); Ours(k=7, c=3, n_{itr}=2).



(a) CMD (E_F = 0.5000)　　(b) NLM (E_F = 0.5074)



(c) RTV(E_F = 0.9026)　　(d) RCD (E_F = 0.5837)　　(e) BTF(E_F = 8404)

(f) TF(E_F =5607)　　(g) SBF (E_F =5000)　　(h) Ours (E_F =0.8280)

Fig.38. CMD(t=25, n_{itr}=4); NLM(p=5, k=7, σ=0.15 , n_{itr}=4); RTV(λ =0.015, σ=4); RCD(k=11, σ=0.25, Model1); BTF(k=7, n_{itr}=3); TF(σ=0.015, σ_s =4); SBF(k=9, n_{itr}=3); Ours(k=11, c=3, n_{itr}=3).

(a) CMD ($E_F = 0.3755$ (b) NLM($E_F = 0.5981$)

(c) RTV ($E_F = 0.09319$) (d) RCD ($E_F = 0.5144$) (e) BTF ($E_F = 0.6890$)

(f) TF ($E_F = 0.9507$) (g) SBF ($E_F = 0.4910$) (h) Ours($E_F = 0.6940$)

Fig.39. CMD(t=25, n_{itr}=3); NLM(p=5, k=7, σ=0.25, n_{itr}=3); RTV(λ =0.015, σ=6); RCD(k=19, σ=0.25, Model1); BTF(k=9, n_{itr}=3); TF(σ=0.015, σ_s=6); SBF(k=9, n_{itr}=3); Ours(k=15,c=3, n_{itr}=3).

(a) CMD ($E_F = 0.3467$)

(b) NLM ($E_F = 0.5000$)

(c) RTV ($E_F = 0.6262$)

(d) RCD ($E_F = 0.4972$)

(e) BTF ($E_F = 0.5927$)

(f) TF ($E_F = 0.7282$)

(g) SBF ($E_F = 0.5000$)

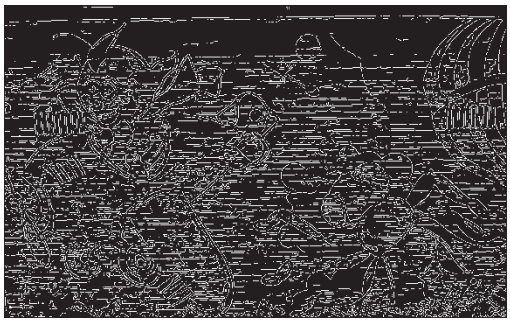
(h) Ours ($E_F = 0.7086$)

Fig.40. CMD(t=15, n_{itr}=2); NLM(p=5, k=7, σ=0.25, n_{itr}=3); RTV(λ =0.01, σ=3); RCD(k=11, σ=0.25, Model1); BTF(k=7, n_{itr}=2); TF(σ=0.015, σ_s=4); SBF(k=7, n_{itr}=3); Ours(k=15,c=3, n_{itr} =2).

Ground-truth for Structure Edges and Texture Edges

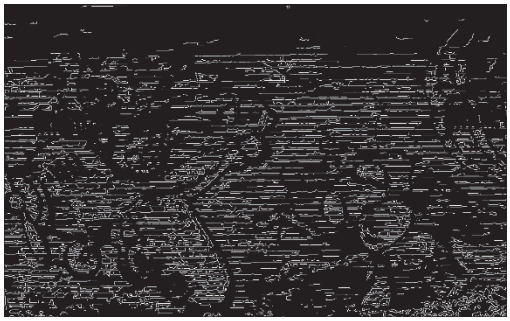
The ground-truth for an image was obtained by the following steps. At first, the Canny operator was used to obtain edges as much as possible with the threshold set much small. Then, 5 graduate students were invited to manually identify the obtained edges as structure edges or texture edges. Here, 40 images were processed.

(a) Input



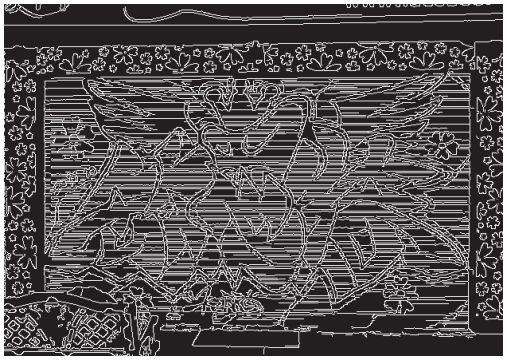
(b) Edges via the canny operator

(c) Structure edges



(d) Texture edges

(a) Input

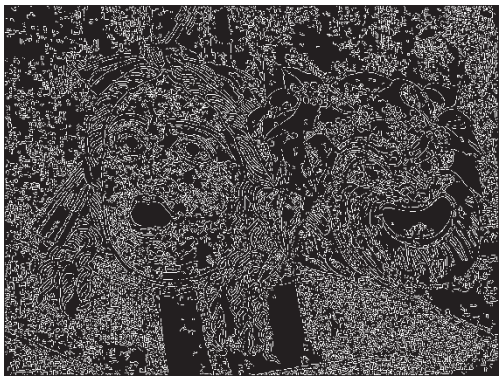


(b) Edges via the canny operator

(c) Structure edges

(d) Texture edges

(a) Input



(b) Edges via the canny operator

(c) Structure edges

(d) Texture edges

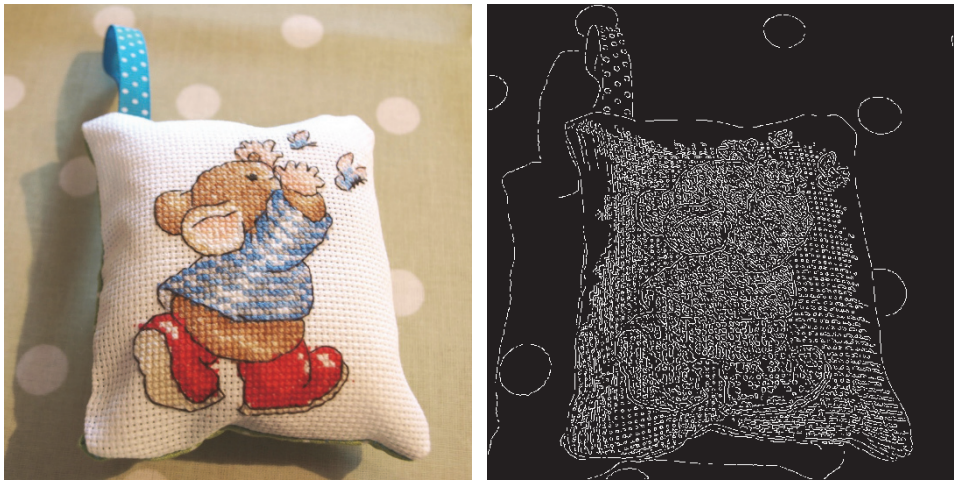
(a) Input

(b) Edges via the canny operator

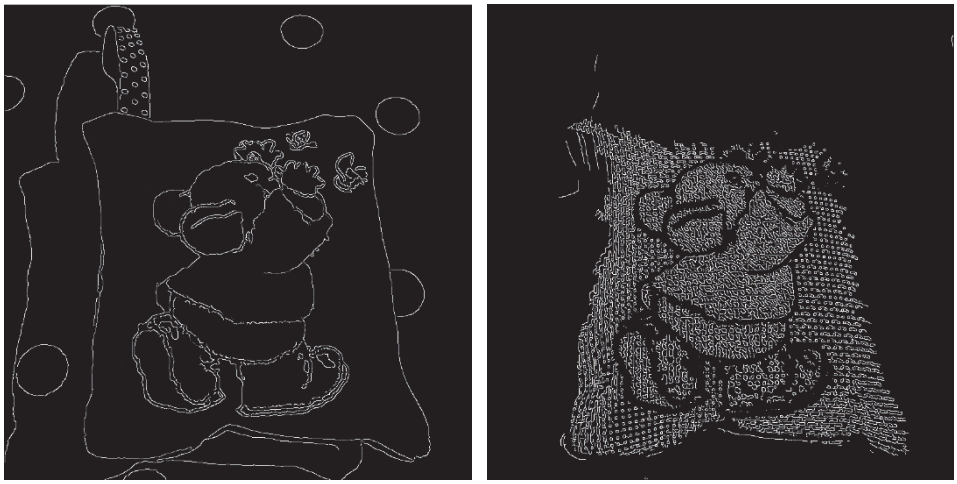
(c) Structure edges

(d) Texture edges

(a)Input (b) Edges via the canny operator (c) Structure edges (d) Texture edges

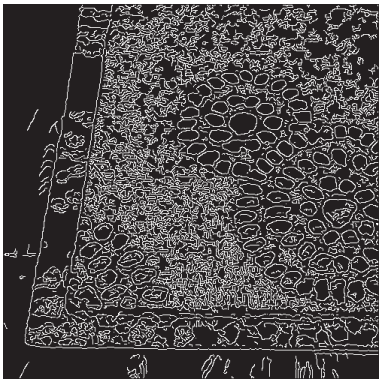


(a) Input (b) Edges via the canny operator

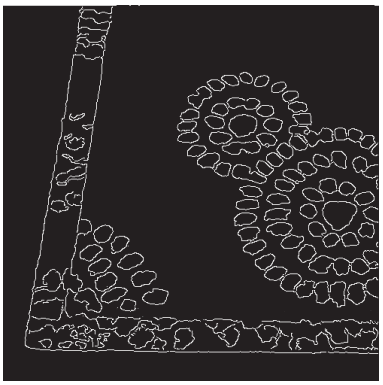


(c) Structure edges (d) Texture edges

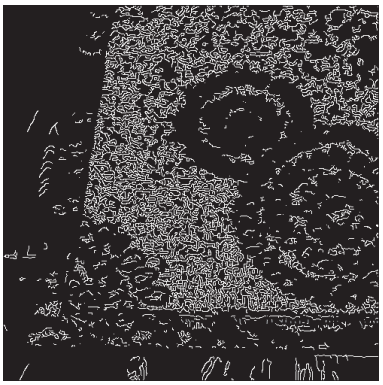
(a) Input



(b) Edges via the canny operator



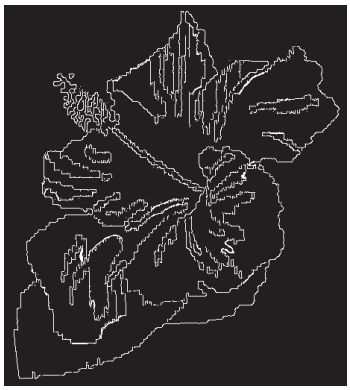
(c) Structure edges



(d) Texture edges

(a) Input

(b) Edges via the canny operator



(c) Structure edges

(d) Texture edges

(a) Input

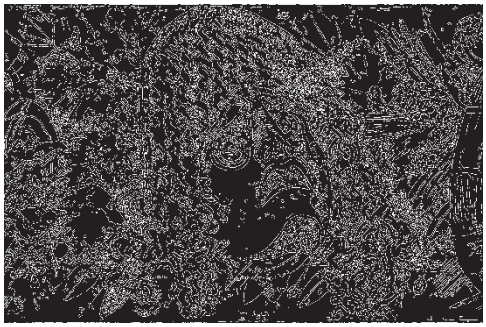
(b) Edges via the canny operator

(c) Structure edges

(d) Texture edges

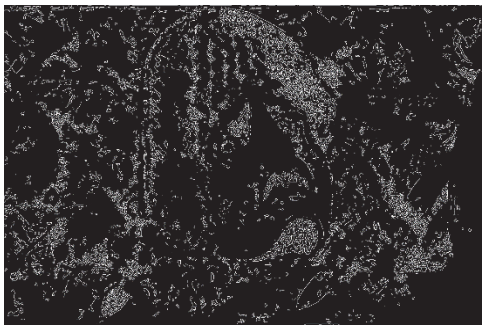
(a)Input (b) Edges via the canny operator (c) Structure edges (d) Texture edges

(a) Input



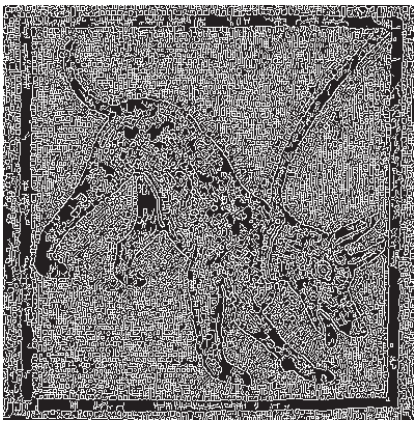
(b) Edges via the canny operator

(c) Structure edges



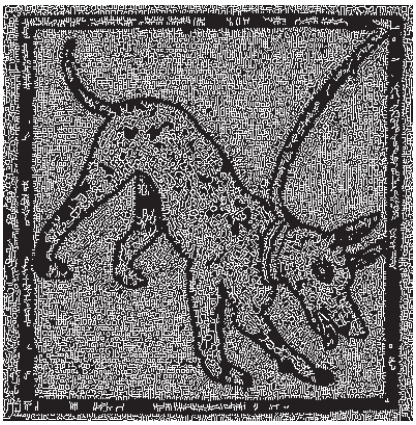
(d) Texture edges

(a) Input

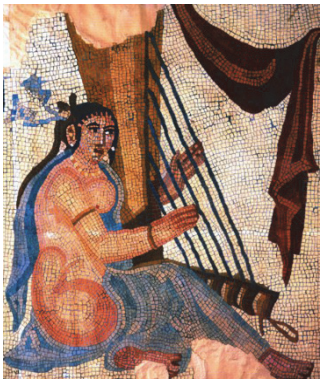


(b) Edges via the canny operator

(c) Structure edges



(d) Texture edges

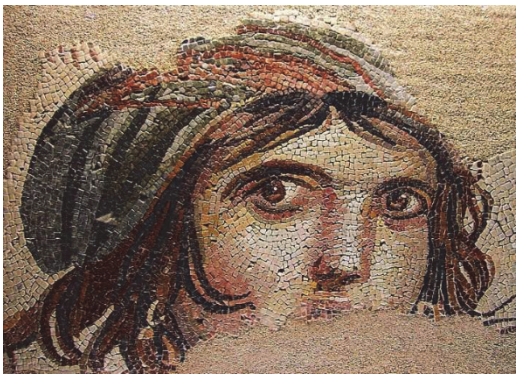


(a) Input

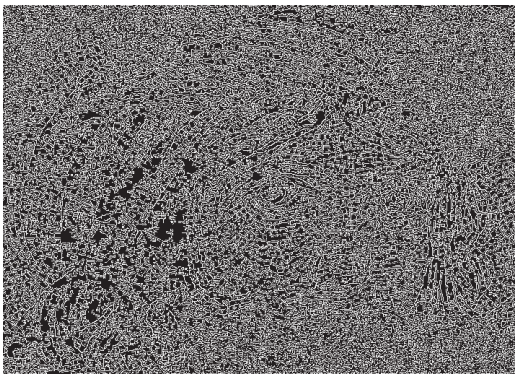
(b) Edges via the canny operator

(c) Structure edges

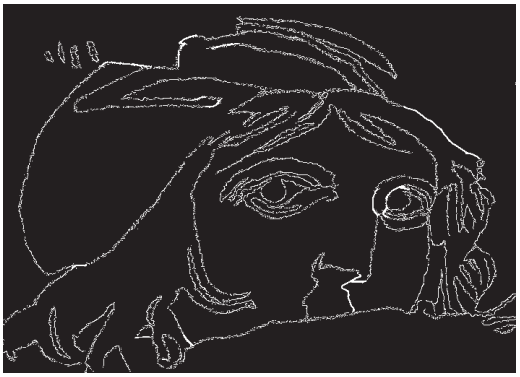
(d) Texture edges



(a) Input



(b) Edges via the canny operator



(c) Structure edges

(d) Texture edges

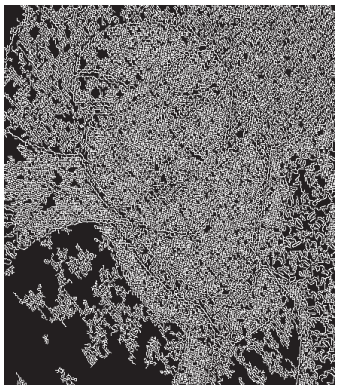
(a) Input

(b) Edges via the canny operator

(c) Structure edges

(d) Texture edges

(a) Input



(b) Edges via the canny operator

(c) Structure edges

(d) Texture edges

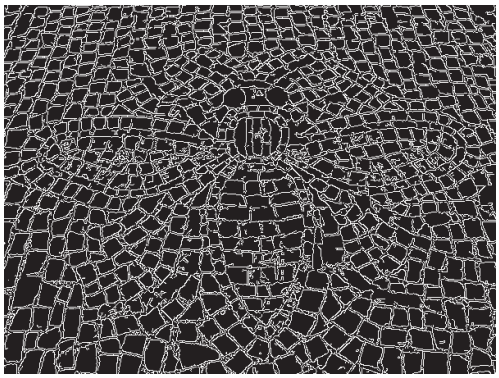
(a)Input (b) Edges via the canny operator (c) Structure edges (d) Texture edges

(a) Input (b) Edges via the canny operator

(c) Structure edges (d) Texture edges

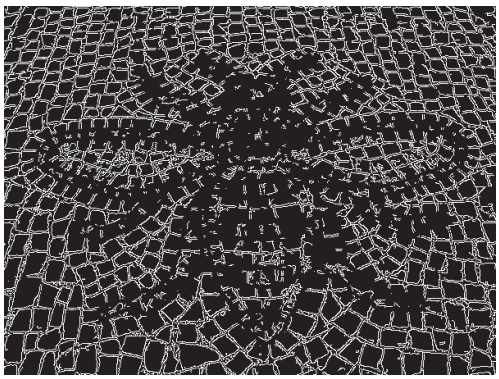
(a)Input (b) Edges via the canny operator (c) Structure edges (d) Texture edges

(a) Input



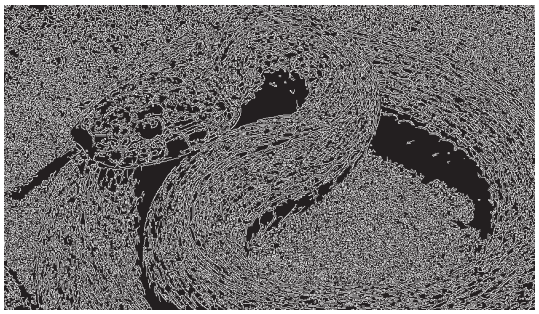
(b) Edges via the canny operator

(c) Structure edges



(d) Texture edges

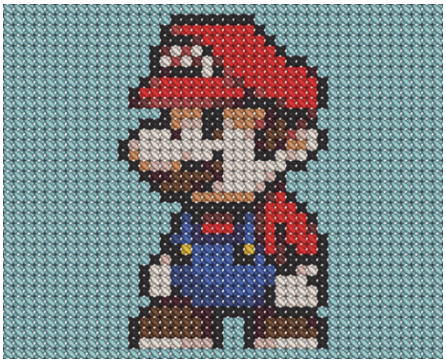
(a) Input



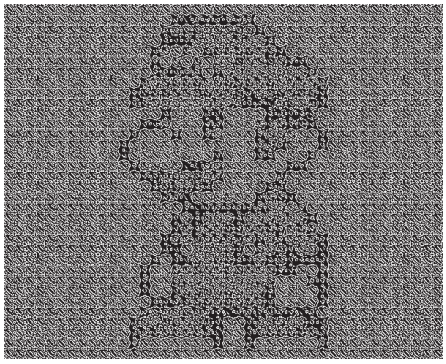
(b) Edges via the canny operator

(c) Structure edges

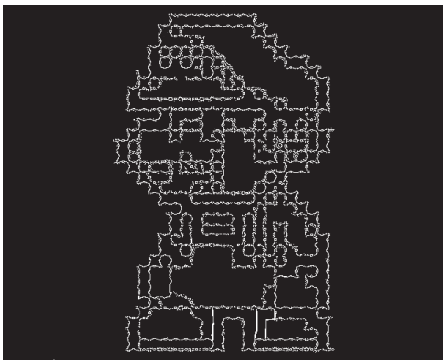
(d) Texture edges



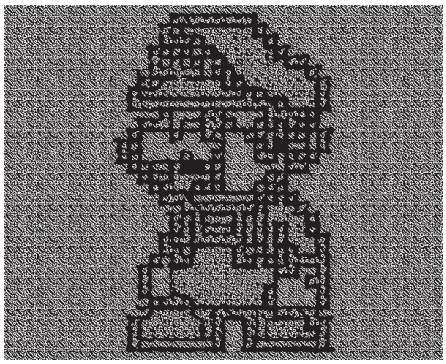
(a) Input



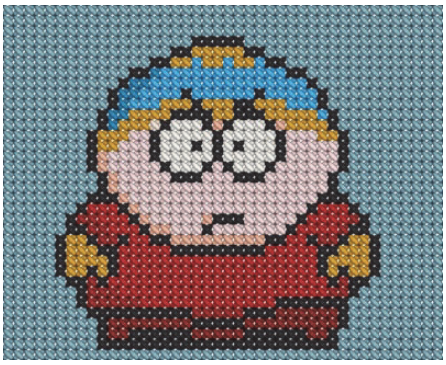
(b) Edges via the canny operator



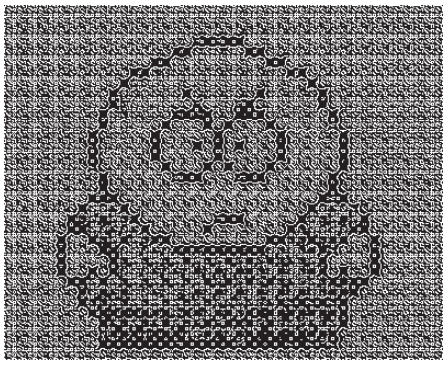
(c) Structure edges



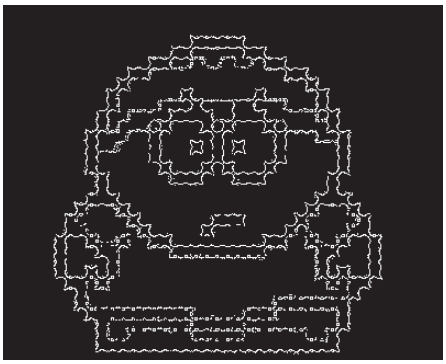
(d) Texture edges



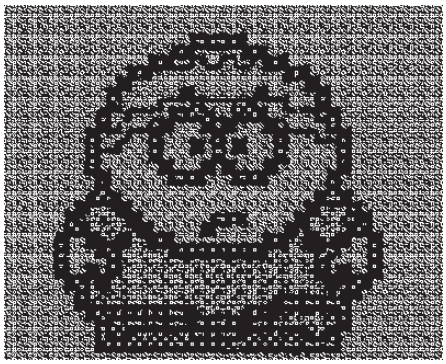
(a) Input



(b) Edges via the canny operator

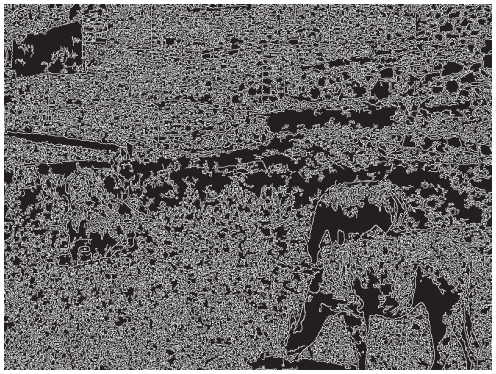


(c) Structure edges



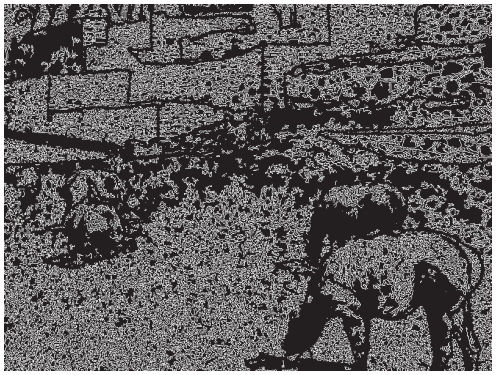
(d) Texture edges

(a) Input



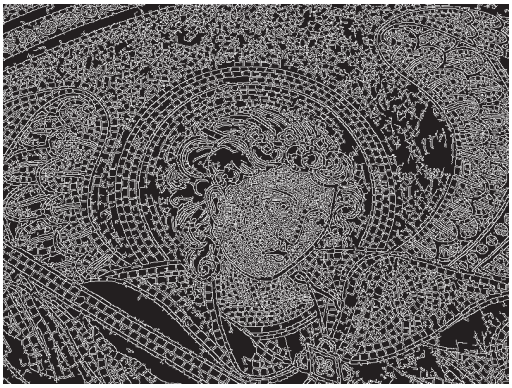
(b) Edges via the canny operator

(c) Structure edges



(d) Texture edges

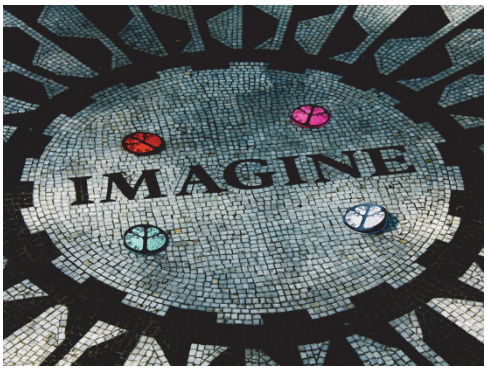
(a) Input



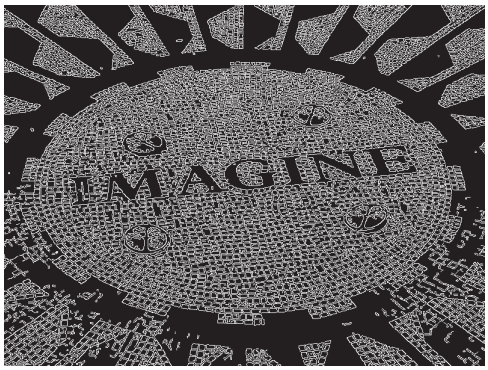
(b) Edges via the canny operator

(c) Structure edges

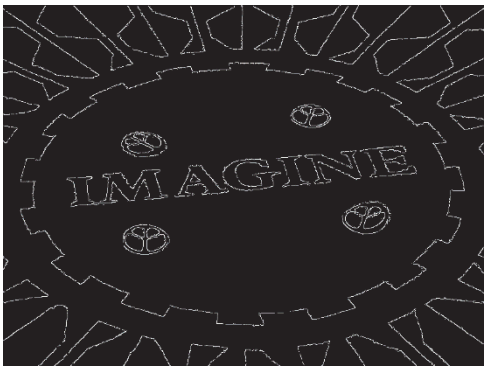
(d) Texture edges



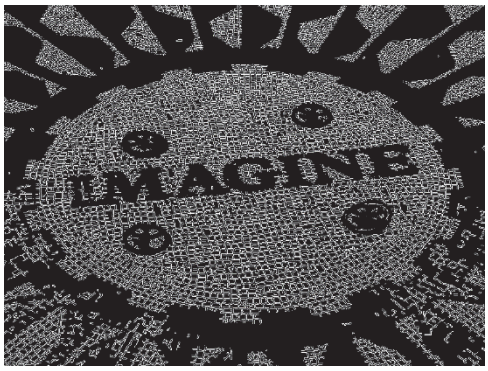
(a) Input



(b) Edges via the canny operator



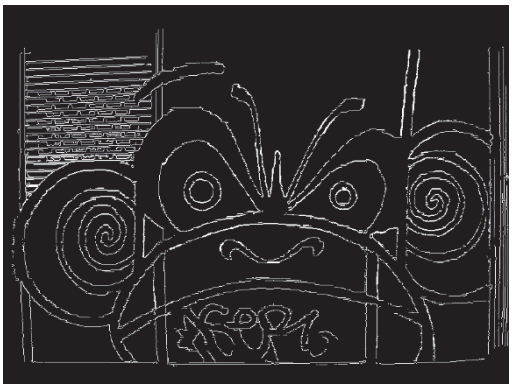
(c) Structure edges



(d) Texture edges

(a) Input

(b) Edges via the canny operator



(c) Structure edges

(d) Texture edges

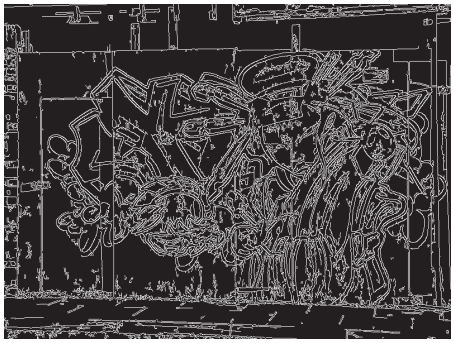
(a) Input

(b) Edges via the canny operator

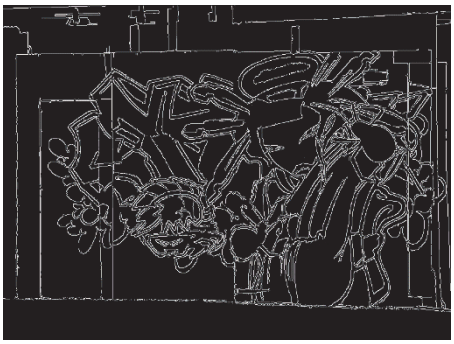
(c) Structure edges

(d) Texture edges

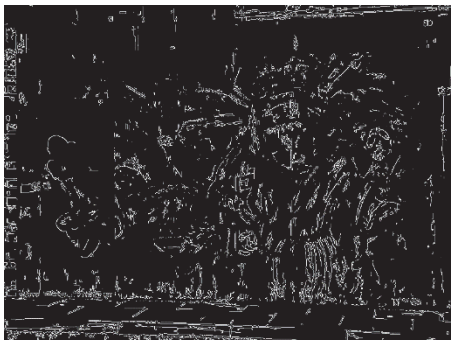
(a) Input



(b) Edges via the canny operator

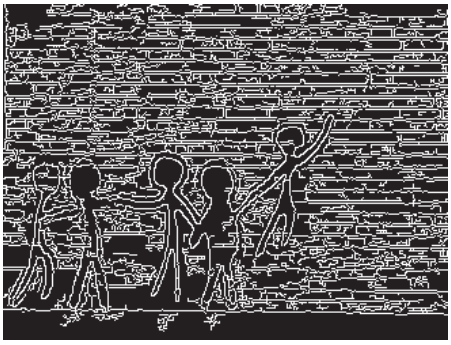


(c) Structure edges



(d) Texture edges

(a) Input



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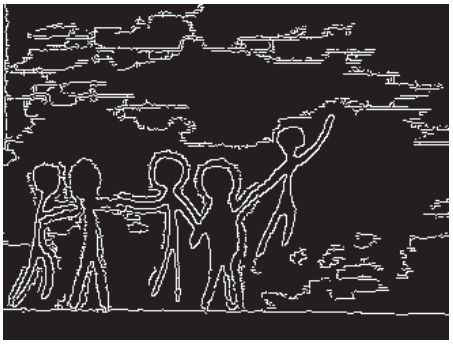
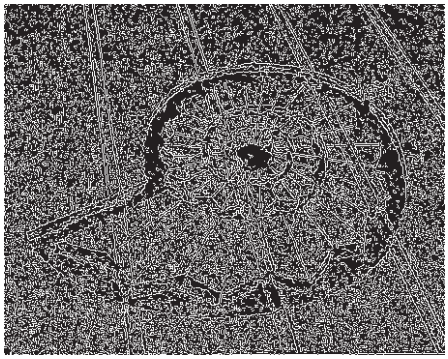


(c) Structure edges

(d) Texture edges

(a) Input



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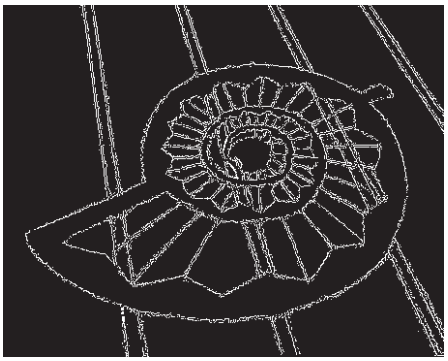
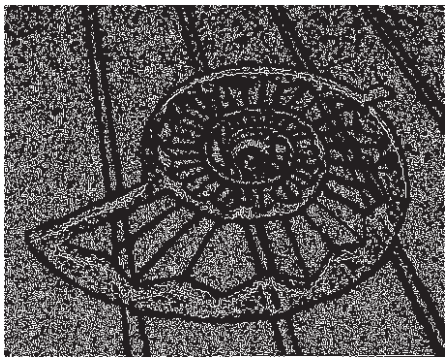
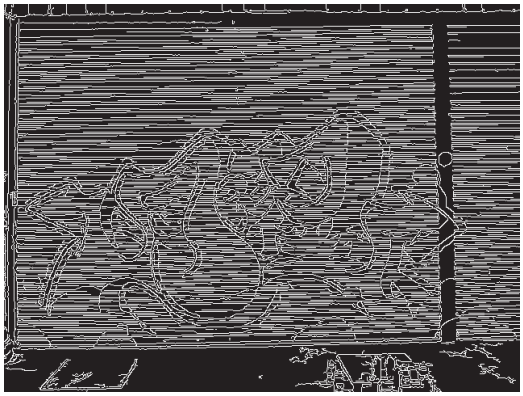


(c) Structure edges



(d) Texture edges

(a) Input

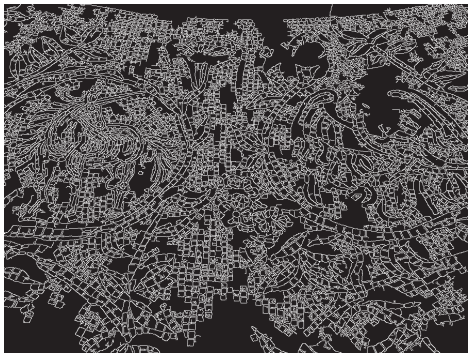


(b) Edges via the canny operator

(c) Structure

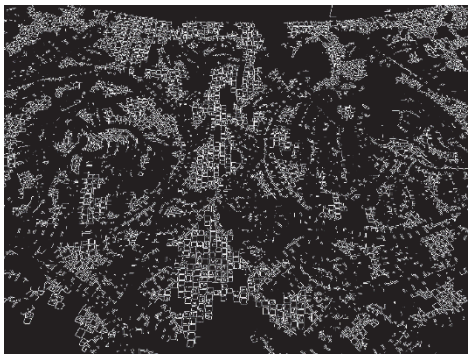
(d) Texture edges

(a) Input

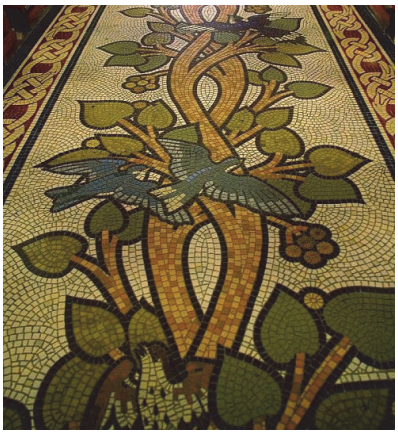


(b) Edges via the canny operator

(c) Structure edges



(d) Texture edges



(a) Input

(b) Edges via the canny operator

(c) Structure edges

(d) Texture edges

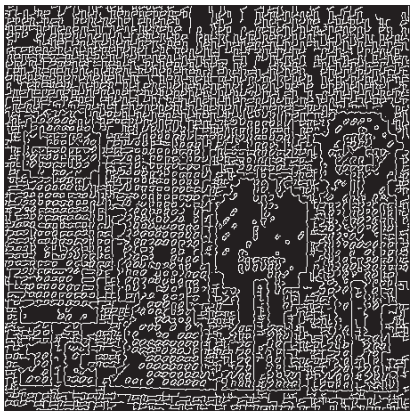
(a) Input

(b) Edges via the canny operator

(c) Structure edges

(d) Texture edges

(a) Input



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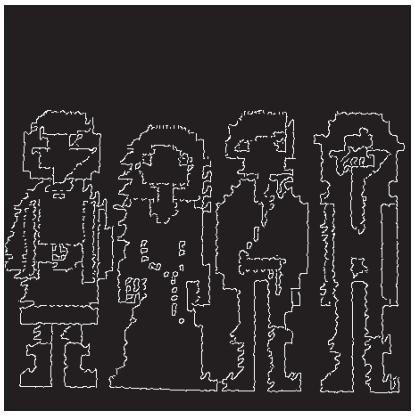
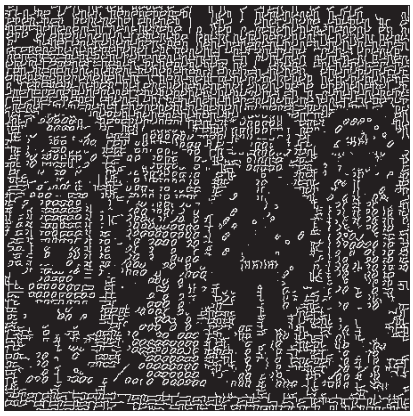
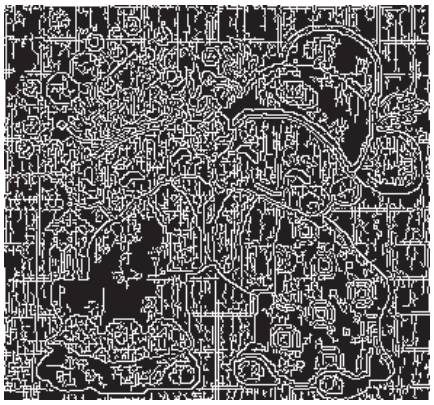


(c) Structure edges



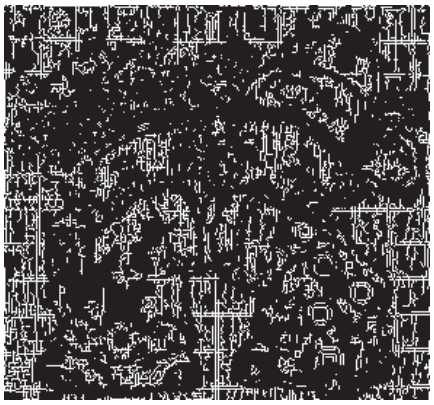
(d) Texture edges

(a) Input

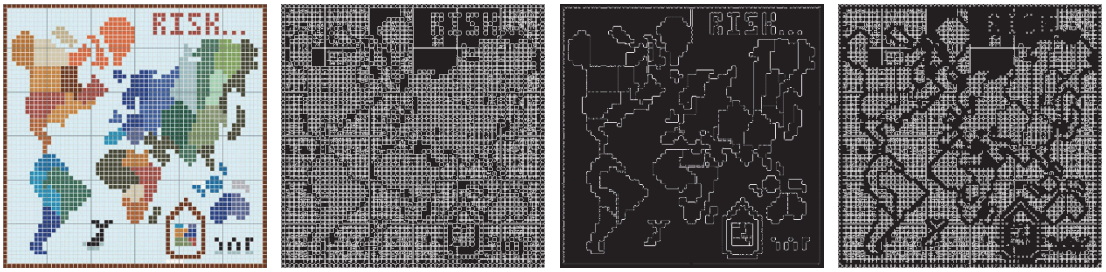


(b) Edges via the canny operator

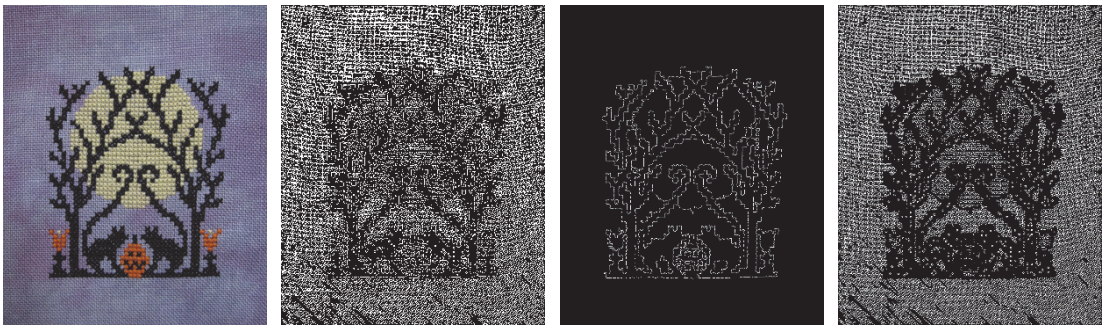
(c) Structure edges



(d) Texture edges

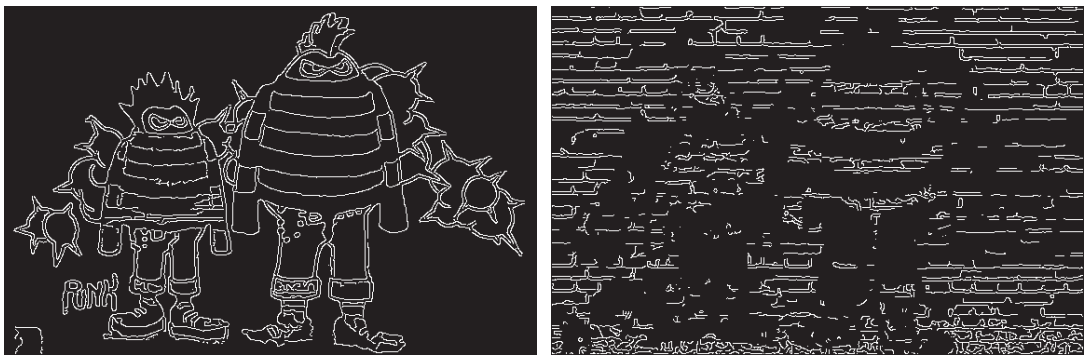


(a)Input (b) Edges via the canny operator (c) Structure edges (d) Texture edges



(a)Input (b) Edges via the canny operator (c) Structure edges (d) Texture edges

(a) Input (b) Edges via the canny operator



(c) Structure edges (d) Texture edges