

Variable Rate Deep Image Compression With a Conditional Autoencoder

Supplementary Materials

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A. Comparison of our refined probabilistic model to [16]

The major difference from [16] is the conditioning part of λ, Δ . Furthermore, there are some differences from [16] in the probabilistic model, which we highlight in Table 1 with red color.

Table 1: Comparison of our refined probabilistic model to [16].

Probability	Modeling in [16]	Modeling in ours
$p_\phi(\mathbf{w}, \mathbf{z} \mathbf{x})$	$p_\phi(\mathbf{z} \mathbf{x})p_\phi(\mathbf{w} \mathbf{z})$	$p_\phi(\mathbf{z} \mathbf{x}, \lambda, \Delta)p_\phi(\mathbf{w} \mathbf{z}, \mathbf{x}, \lambda, \Delta)$
$q_\theta(\mathbf{x} \mathbf{w}, \mathbf{z})$	$\delta(\mathbf{x} - g_\theta(\mathbf{z}))$	$\delta(\mathbf{x} - g_\theta(\mathbf{z}, \mathbf{w}, \lambda))$
$q_\theta(\mathbf{z} \mathbf{w})$	$\prod_i q_\theta(z_i z_{<i}, \mathbf{w})$	$\prod_i q_\theta(z_i z_{<i}, \mathbf{w}, \lambda, \Delta)$
$q_\theta(\mathbf{w})$	$\prod_i q_\theta(w_i)$	$\prod_i q_\theta(w_i \mathbf{w}_{<i}, \lambda, \Delta)$

B. More example images

As supplementary materials, we provide more example images produced by our variable-rate image compression network that is optimized for the MSE loss. We compare our method to the classical image compression codecs, i.e., JPEG, JPEG2000, and BPG. We adapt and match the compression rate of our variable-rate network to the rate of BPG by adjusting the Lagrange multiplier λ and the quantization bin size Δ . All the examples show that our method outperforms the state-of-the-art BPG codec in both PSNR and MS-SSIM measures at the same bits per pixel (BPP). Visually, our method provides better quality with less artifacts than the classical image compression codecs. We put orange boxes to highlight the visual differences in Figure 11,13,15,17,19,21, and the orange-boxed areas are magnified in Figure 12,14,16,18,20,22, respectively.



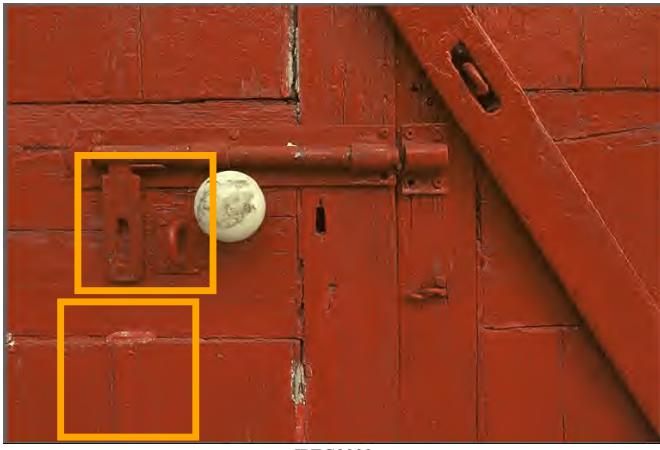
Ground truth



Ours
BPP: 0.1950, PSNR: 32.5684 (dB), MS-SSIM: 0.9434



BPG (4:4:4)
BPP: 0.1950, PSNR: 32.4526 (dB), MS-SSIM: 0.9365



JPEG2000
BPP: 0.1958, PSNR: 31.1678 (dB), MS-SSIM: 0.9165



JPEG
BPP: 0.1925, PSNR: 28.7086 (dB), MS-SSIM: 0.8588

Figure 11: PSNR, MS-SSIM, and visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 02. Our method outperforms the state-of-the-art BPG codec in both PSNR and MS-SSIM measures. We put orange boxes to highlight the visual differences.

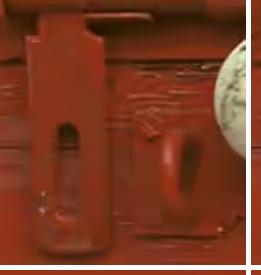
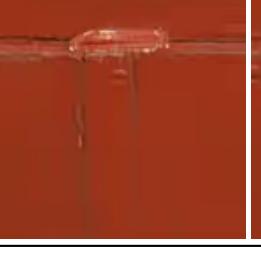
Ground truth	Ours	BPG (4:4:4)	JPEG2000	JPEG
				
				
Bits per pixel (BPP)	0.1950	0.1950	0.1958	0.1925
PSNR (dB)	32.5684	32.4526	31.1678	28.7086
MS-SSIM	0.9434	0.9365	0.9165	0.8588

Figure 12: Visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 02 in the orange-boxed areas of Figure 11.

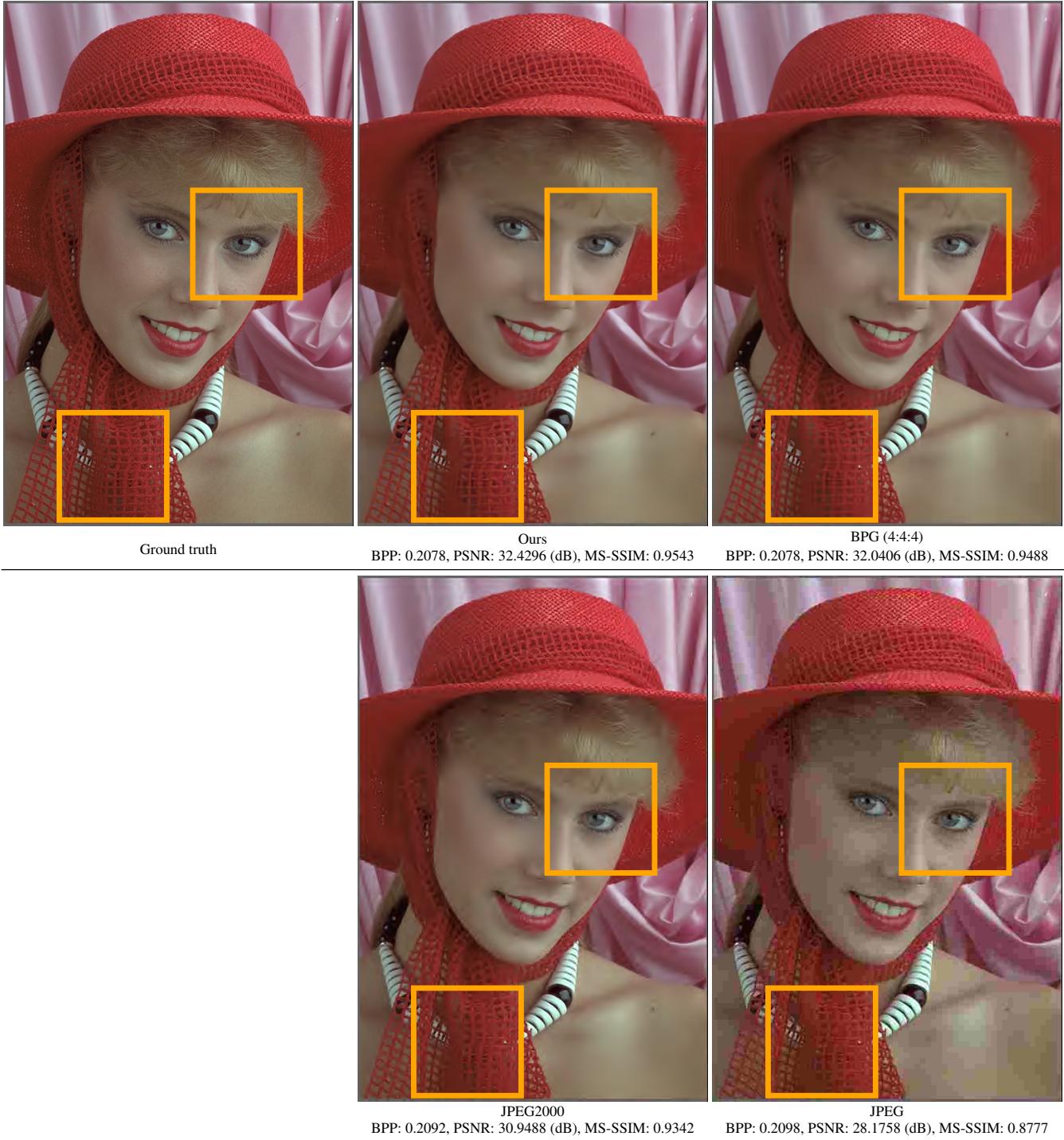


Figure 13: PSNR, MS-SSIM, and visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 04. Our method outperforms the state-of-the-art BPG codec in both PSNR and MS-SSIM measures. We put orange boxes to highlight the visual differences.

Ground truth	Ours	BPG (4:4:4)	JPEG2000	JPEG
				
				
Bits per pixel (BPP)	0.2078	0.2078	0.2092	0.2098
PSNR (dB)	32.4296	32.0406	30.9488	28.1758
MS-SSIM	0.9543	0.9488	0.9342	0.8777

Figure 14: Visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 04 in the orange-boxed areas of Figure 13.

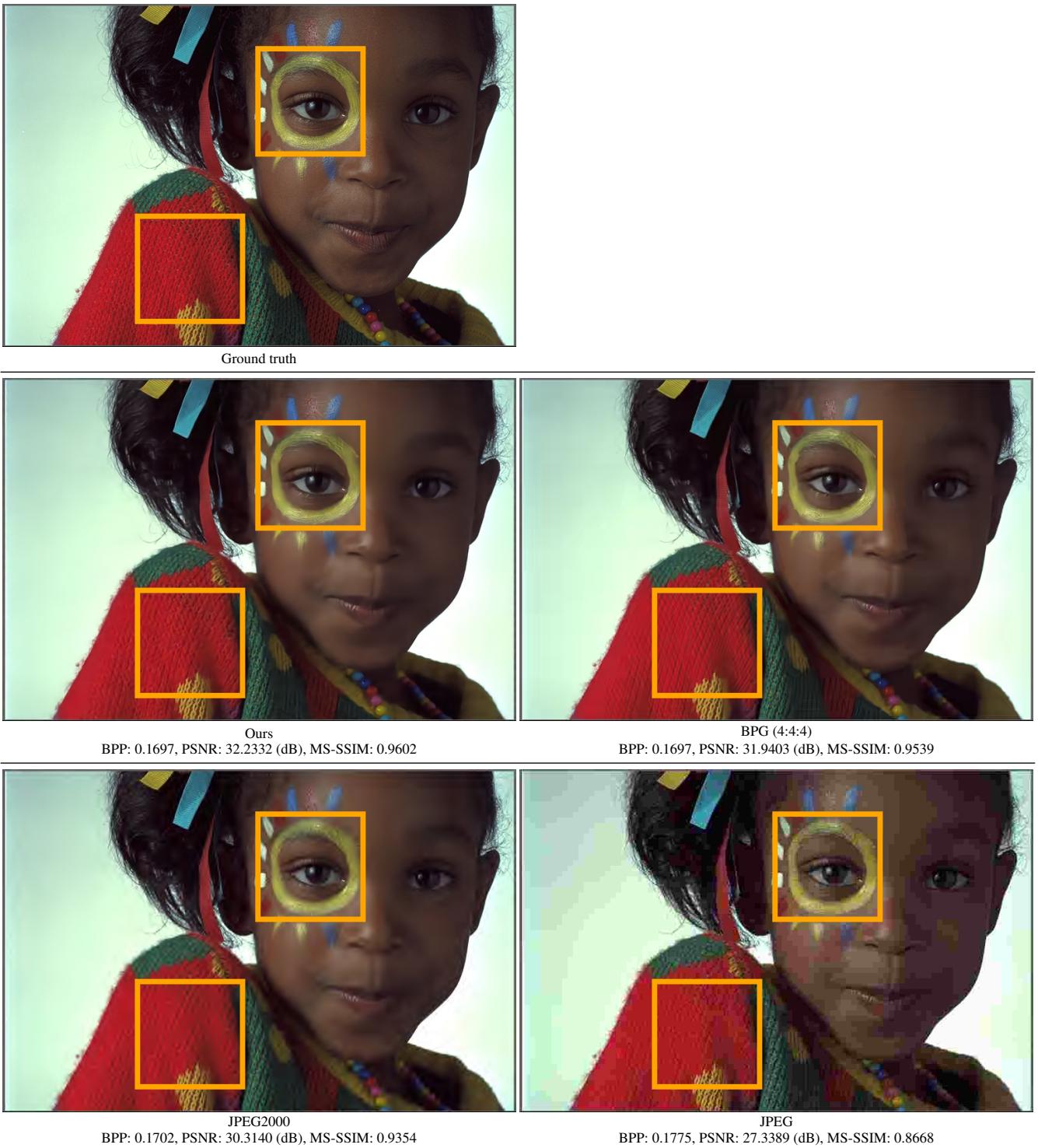


Figure 15: PSNR, MS-SSIM, and visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 15. Our method outperforms the state-of-the-art BPG codec in both PSNR and MS-SSIM measures. We put orange boxes to highlight the visual differences.

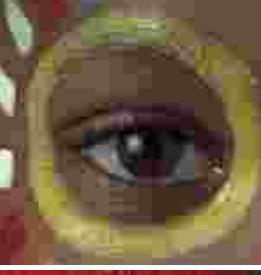
Ground truth	Ours	BPG (4:4:4)	JPEG2000	JPEG
				
				
Bits per pixel (BPP) PSNR (dB) MS-SSIM	0.1697 32.2332 0.9602	0.1697 31.9403 0.9539	0.1702 30.3140 0.9354	0.1775 27.3389 0.8668

Figure 16: Visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 15 in the orange-boxed areas of Figure 15.

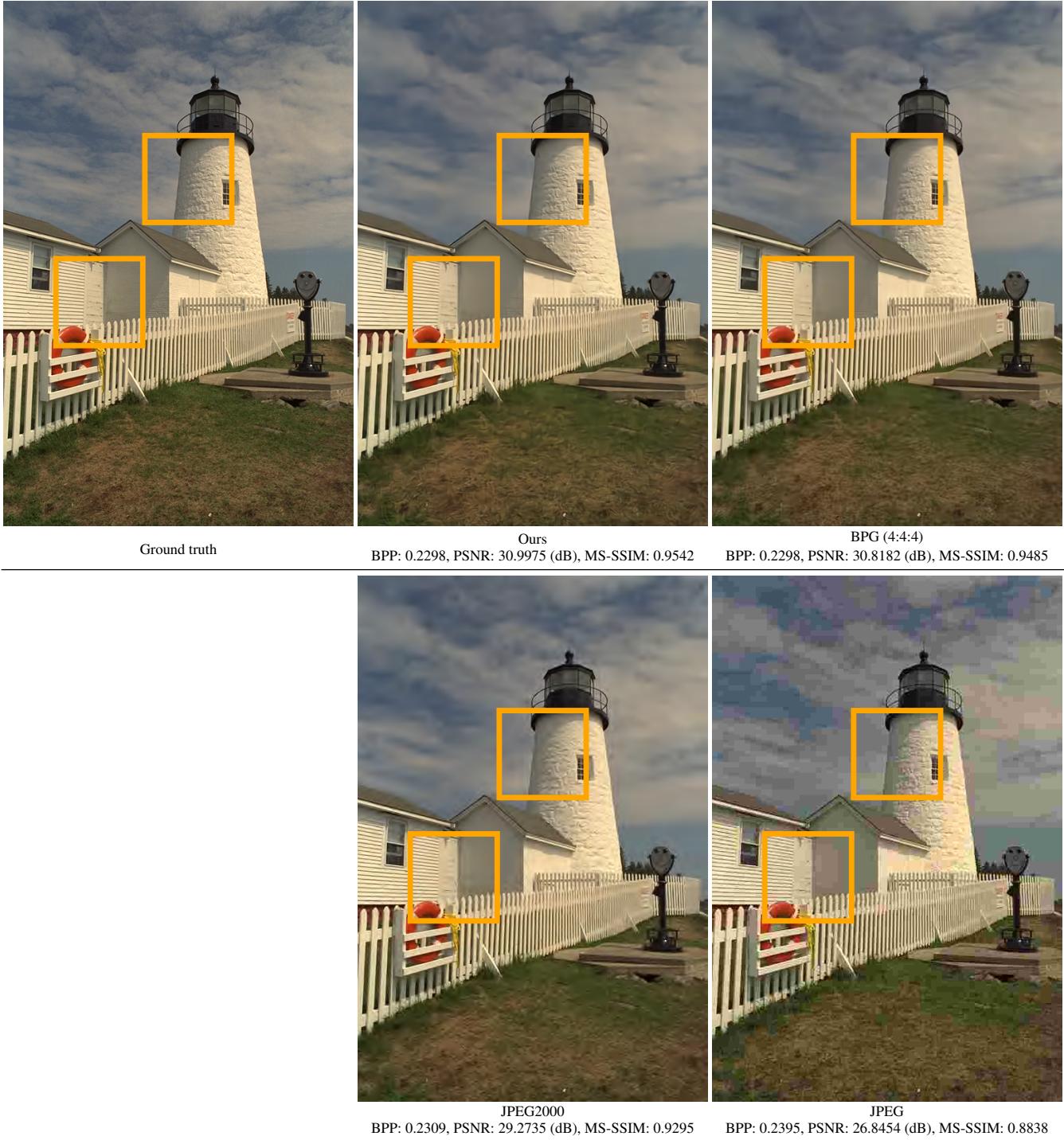
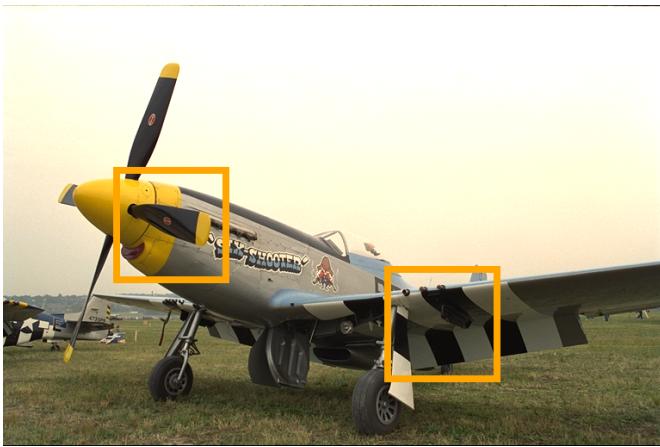


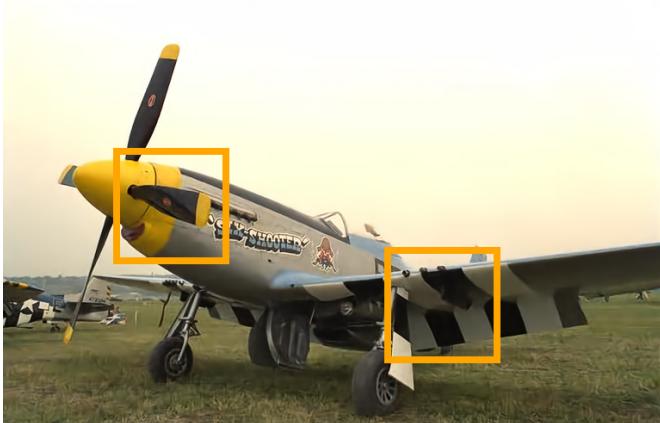
Figure 17: PSNR, MS-SSIM, and visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 19. Our method outperforms the state-of-the-art BPG codec in both PSNR and MS-SSIM measures. We put orange boxes to highlight the visual differences.

Ground truth	Ours	BPG (4:4:4)	JPEG2000	JPEG
				
				
Bits per pixel (BPP) PSNR (dB) MS-SSIM	0.2298 30.9975 0.9542	0.2298 30.8182 0.9485	0.2309 29.2735 0.9295	0.2395 26.8454 0.8838

Figure 18: Visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 19 in the orange-boxed areas of Figure 17.



Ground truth



Ours

BPP: 0.1855, PSNR: 33.2626 (dB), MS-SSIM: 0.9753



BPG (4:4:4)

BPP: 0.1855, PSNR: 32.9725 (dB), MS-SSIM: 0.9719



JPEG2000

BPP: 0.1866, PSNR: 31.0575 (dB), MS-SSIM: 0.9587



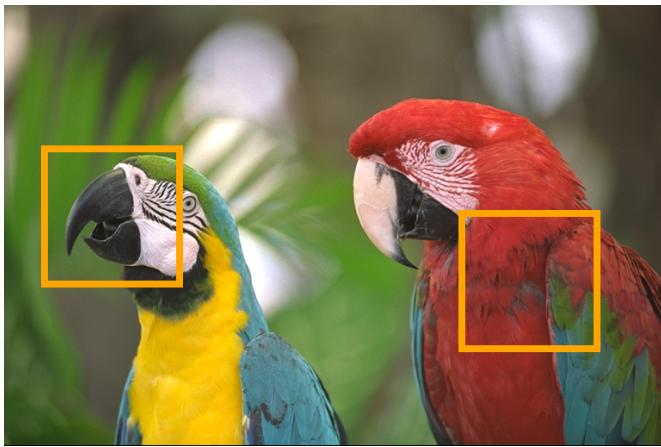
JPEG

BPP: 0.1887, PSNR: 28.2723 (dB), MS-SSIM: 0.9257

Figure 19: PSNR, MS-SSIM, and visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 20. Our method outperforms the state-of-the-art BPG codec in both PSNR and MS-SSIM measures. We put orange boxes to highlight the visual differences.

Ground truth	Ours	BPG (4:4:4)	JPEG2000	JPEG
				
				
Bits per pixel (BPP)	0.1855	0.1855	0.1866	0.1887
PSNR (dB)	33.2626	32.9725	31.0575	28.2723
MS-SSIM	0.9753	0.9719	0.9587	0.9257

Figure 20: Visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 20 in the orange-boxed areas of Figure 19.



Ground truth

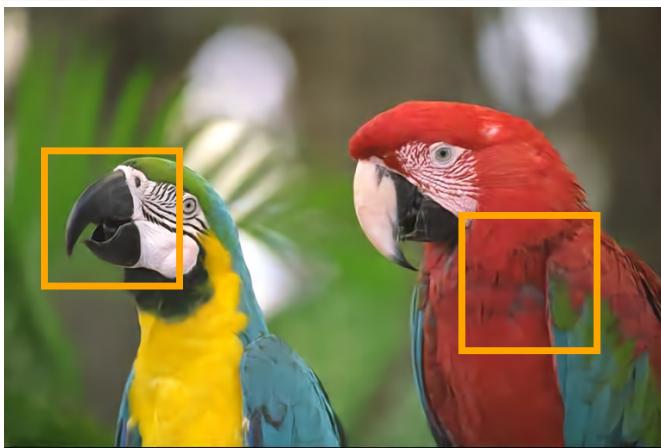
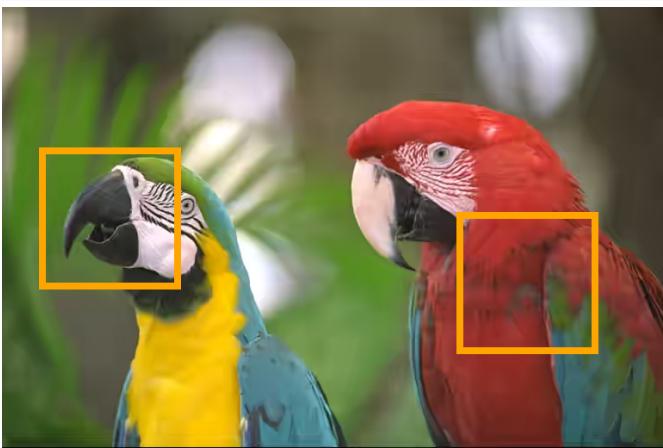
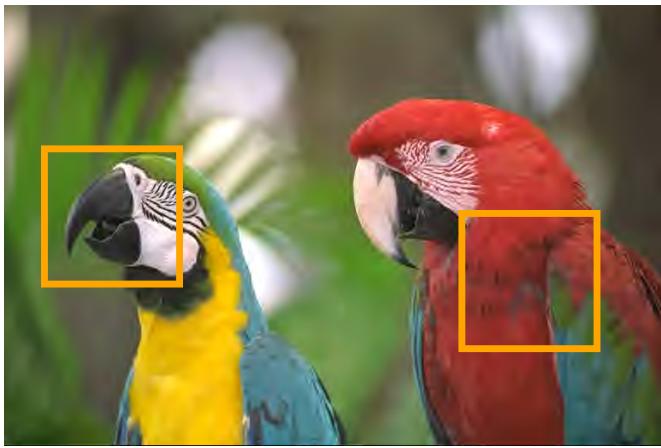
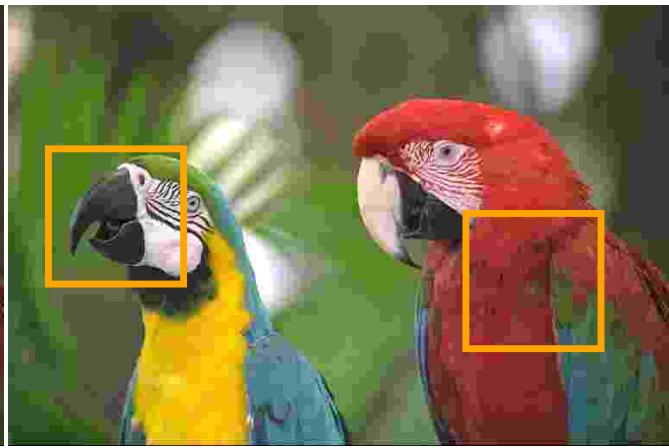
Ours
BPP: 0.1289, PSNR: 34.4543 (dB), MS-SSIM: 0.9695BPG (4:4:4)
BPP: 0.1289, PSNR: 33.3546 (dB), MS-SSIM: 0.9593JPEG2000
BPP: 0.1298, PSNR: 31.8927 (dB), MS-SSIM: 0.9482JPEG
BPP: 0.1299, PSNR: 27.1270 (dB), MS-SSIM: 0.8404

Figure 21: PSNR, MS-SSIM, and visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 23. Our method outperforms the state-of-the-art BPG codec in both PSNR and MS-SSIM measures. We put orange boxes to highlight the visual differences.

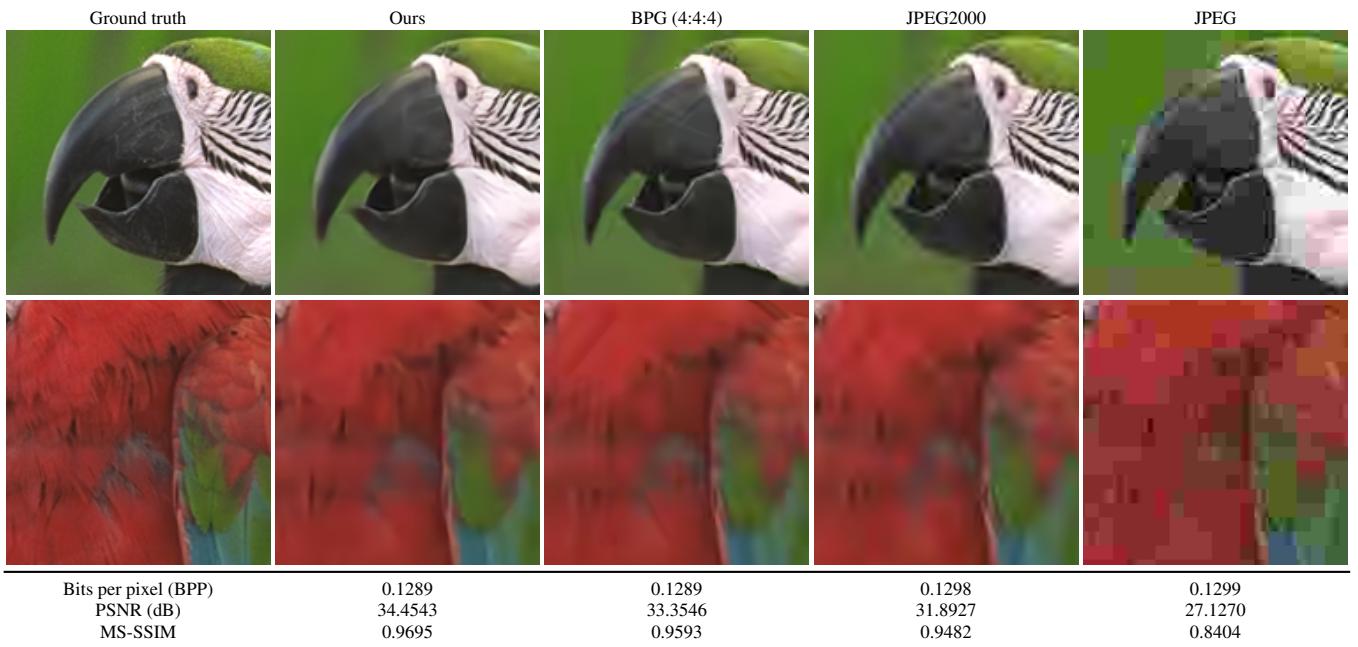


Figure 22: Visual quality comparison of our variable-rate deep image compression method and classical image compression algorithms (BPG, JPEG2000, and JPEG) for the Kodak image 23 in the orange-boxed areas of Figure 21.