

# Supplementary Materials: Blind Video Bit-Depth Expansion

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## 1 INTRODUCTION OF BIT-DEPTH EXPANSION (BDE) TASK

With the development of high-bit-depth (HBD) display devices, such as UHD TVs and mobile phones, current low-bit-depth (LBD) images and videos usually suffer from banding artifacts (false contours) and color distortion when displayed on HBD screens. The goal of Bit-depth expansion (BDE) is to generate high-quality HBD images or videos from LBD inputs, as illustrated in Fig. 1.

## 2 STRUCTURE OF TRANSBLOCK

The structure of the TransBlock in the reconstruction module is illustrated in Fig. 2. This TransBlock is simply modified from the basic transformer blocks in [1] [2]. In the feed-forward network, an extra dilated convolution branch with channel expansion is added to capture more spatial information. In this paper, the channel expansion factors  $\gamma$  of the ten TransBlocks are set to 1, 1, 2, 2, 4, 4, 2, 2, 1, and 1, respectively.

## 3 MORE SUBJECTIVE RESULTS

The banding artifacts are more perceptible in large flat areas. Due to the space constraints of the manuscript, we have added more subjective results in Fig. 3 and Fig. 4. From these figures, it can be observed that the proposed method robustly removes severe banding artifacts while maintaining better color fidelity than other SOTA methods.

## 4 EXTENDED EXPERIMENTS ON REAL-WORLD BANDING FRAMES

To further verify the generalization and robustness of the proposed method, extended experiments are implemented on real-world banding videos with unknown degradations. The test results of different methods are illustrated in Fig. 5. Some examples of 1-D curves are also shown in Fig. 5 for convenient comparison. We can find that the proposed blind video BDE method and blind de-contouring network (BDCN) [3] can reproduce smoother and better flat regions than other models, which verifies the robustness of blind models. The proposed method can recover more accurate color than BDCN.

Because there is a lack of GT for these real-world frames, the mean opinion score (MOS) is employed to evaluate the quality of the reconstructed images. To obtain MOS, 16 observers are invited to score the visual quality of BDE results from 1 (the worst) to 5 (the best). Note that these BDE results are displayed anonymously in random order. The MOS results are listed in Table 1, from which we can find that the proposed method still obtains the highest score.

## 5 MERGING OF DEGRADATION TYPES

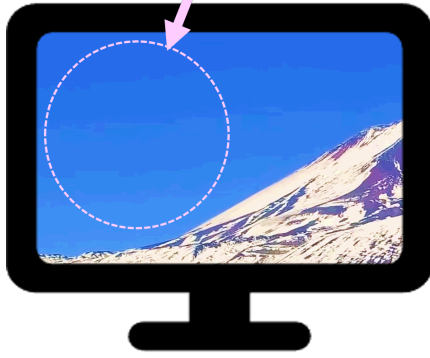
Fig. 6 shows the merging process of different BDE degradation types. As mentioned in the manuscript, there are a total of 26 types of degradations after filtering the degradation settings with significant defects. Then, the degradation settings that produced

similar or identical values are further merged, resulting in a total of 14 different degradation types, as shown in Fig. 6.

## REFERENCES

- [1] Xiang Li, Jiangxin Dong, Jinhui Tang, and Jinshan Pan. 2023. Dlganet: Lightweight dynamic local and global self-attention networks for image super-resolution. In *Proceedings of the IEEE/CVF International Conference on Computer Vision*. 12792–12801.
- [2] Syed Waqas Zamir, Aditya Arora, Salman Khan, Munawar Hayat, Fahad Shah-baz Khan, and Ming-Hsuan Yang. 2022. Restormer: Efficient transformer for high-resolution image restoration. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*. 5728–5739.
- [3] Yang Zhao, Wei Jia, Yuan Chen, and Ronggang Wang. 2022. Fast blind decontouring network. *IEEE Transactions on Circuits and Systems for Video Technology* 33, 2 (2022), 478–490.

Banding artifacts & Color distortion



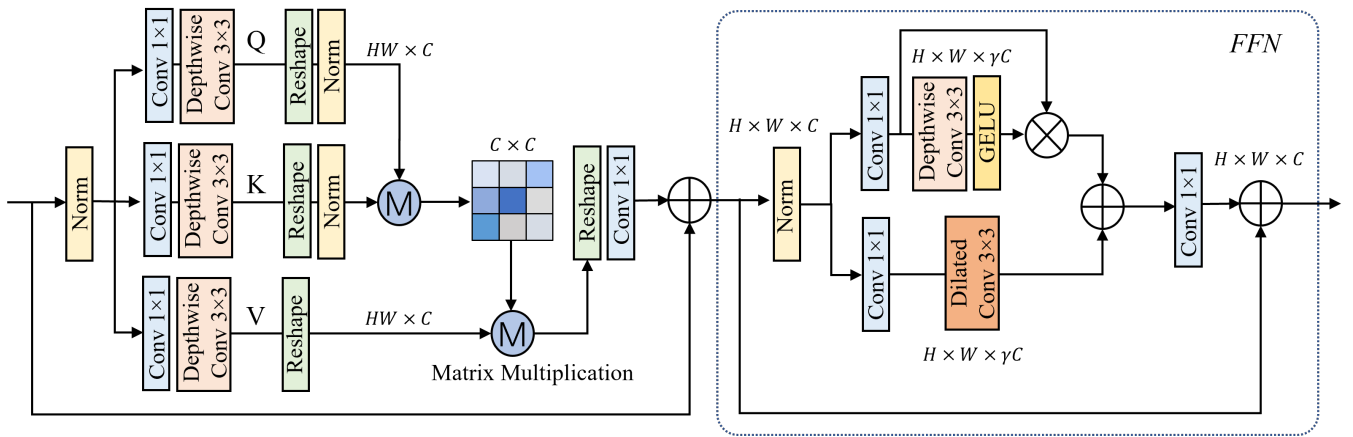
**LBD frame**  
displayed on HBD screen

**Bit-Depth  
Expansion  
(BDE)**



**Reconstructed  
HBD frame**

**Figure 1: Illustration of BDE task.**



**Figure 2: Structure of lightweight Transformer blocks (TransBlock).**

**Table 1: The MOS results of different methods on real-world video test set.**

	FFmpeg Filter	AdaDeband	BDEN-retrain	LBDEn-retrain	BDCN	BRNet	MSTFN-retrain	Our
Mean Opinion Score (MOS)↑	<u>4.03</u>	3.36	2.68	2.82	3.36	3.09	1.85	<b>4.26</b>

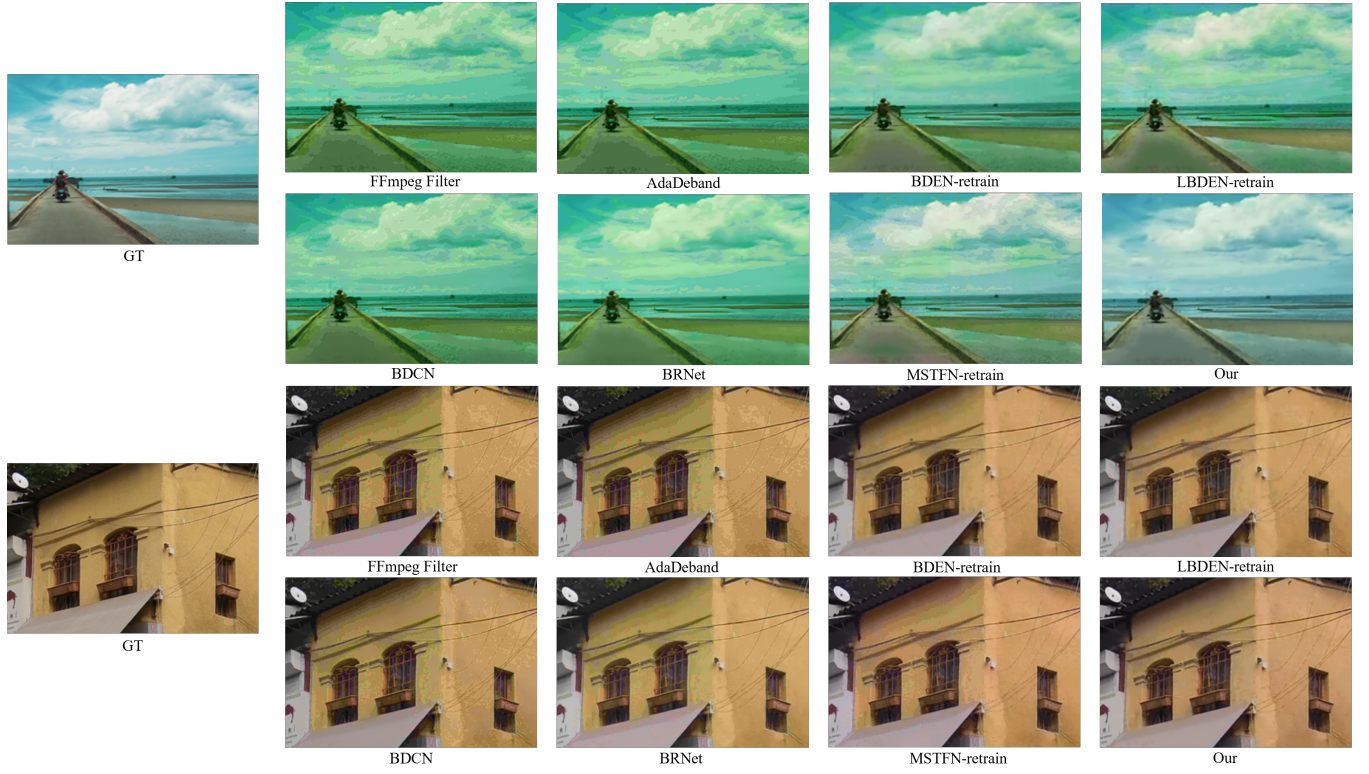


Figure 3: Visualization of additional 4-8-bit subjective results. The top section shows results from the Vimeo-90K dataset, while the bottom section shows results from the REDS dataset.

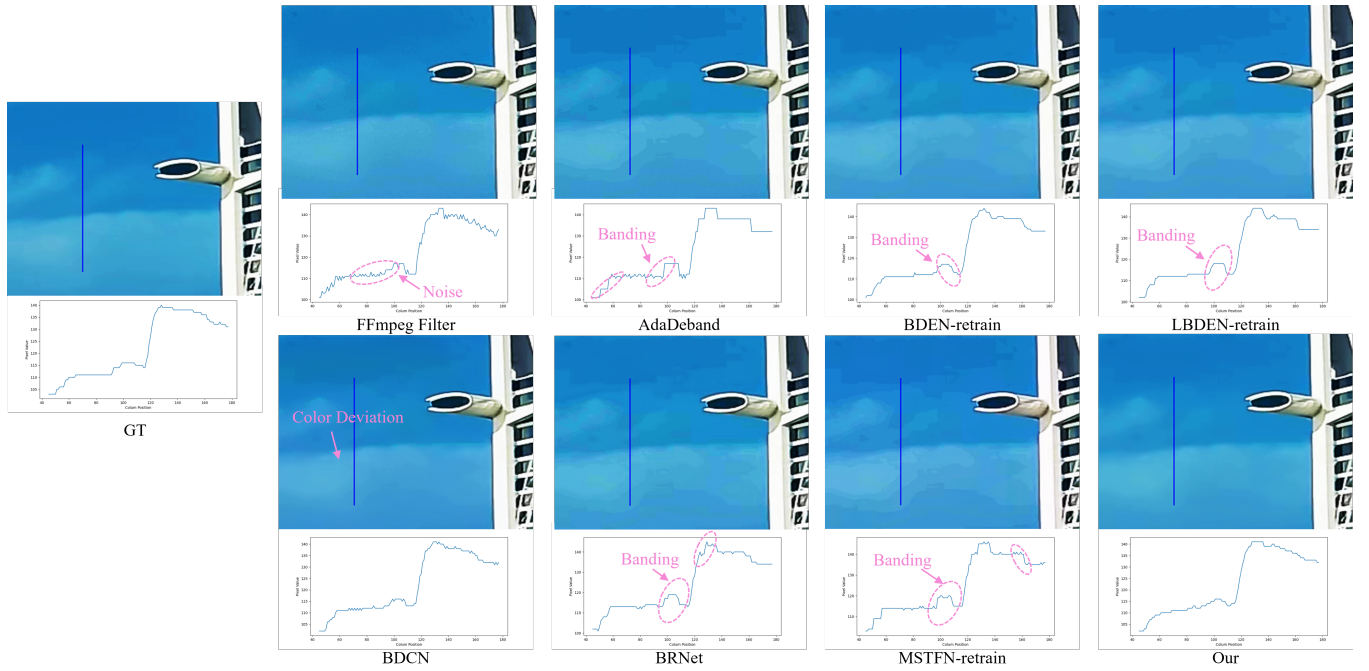


Figure 4: Visualization of single-frame restoration for 6-8-bit videos on our test set. Each image also shows the variation of a column of pixels.



**Figure 5: BDE results for some real-world videos with banding artifacts. For the convenience of comparison, 1-D curves are also plotted, which shows the gray values of a row or column of pixels.**








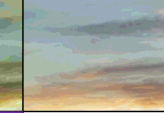














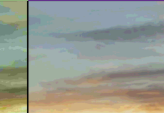
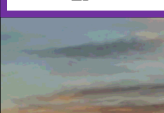
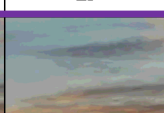
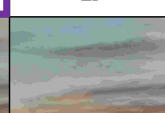
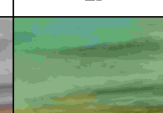
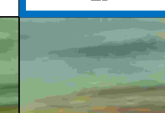
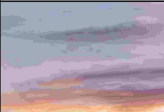
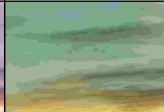
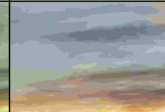
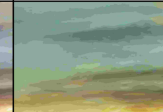
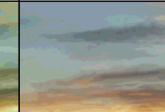
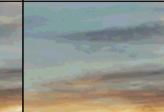
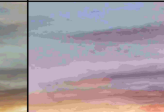
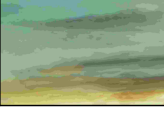
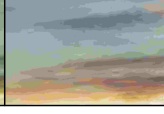
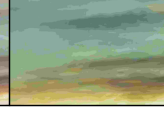
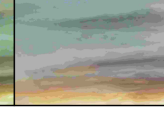
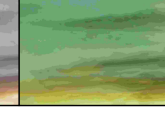
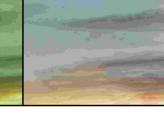
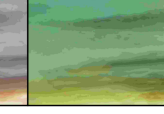
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$f_{DQ}^\uparrow$	<i>Ceil;MIG</i>	<i>Floor;MIG</i>	<i>Round;MIG</i>	<i>BR</i>	<i>ZP</i>	<i>Ceil;MIG</i>	<i>Floor;MIG</i>
							
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Color Space	RGB	RGB	RGB	RGB	RGB	YCbCr	YCbCr
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$f_{DQ}^\uparrow$	<i>Round;MIG</i>	<i>BR</i>	<i>ZP</i>	<i>ZP</i>	<i>ZP</i>	<i>Ceil;MIG</i>	<i>Floor;MIG</i>
							
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$f_{DQ}^\uparrow$	<i>ZP</i>	<i>ZP</i>	<i>ZP</i>	<i>ZP</i>	<i>ZP</i>		
							
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Color Space	YUV	YUV	YUV	YUV	RGB	RGB	YCbCr
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$f_{DQ}^\uparrow$	<i>Ceil;MIG</i>	<i>Floor;MIG</i>	<i>BR</i>	<i>ZP</i>	<i>Floor;MIG</i>	<i>ZP</i>	<i>Ceil;MIG</i>
							
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Color Space	YCbCr	YCbCr	YCbCr	YUV	YUV	YCbCr	YCbCr
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$f_{DQ}^\uparrow$	<i>Floor;MIG</i>	<i>BR</i>	<i>ZP</i>	<i>ZP</i>	<i>ZP</i>	<i>ZP</i>	<i>ZP</i>
							

Figure 6: Visualizing of the merging process of BDE degradation types.