Supervised Raw Video Denoising with a Benchmark Dataset on Dynamic Scenes

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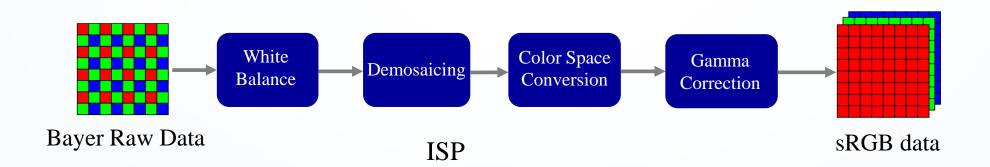
https://github.com/cao-cong/RViDeNet

1 研究背景

□ 由于ISP过程的影响，sRGB域噪声特性复杂。

□ Raw域数据信息更为丰富，且与曝光量成线性响应。

Bayer Raw Data → White Balance → Demosaicing → Color Space Conversion → Gamma Correction → sRGB data

ISP

☐ 带噪-干净图像数据集不断涌现，实际图像去噪算法取得显著进展。

☐ 带噪-干净视频数据集缺失，实际视频去噪算法研究较少。
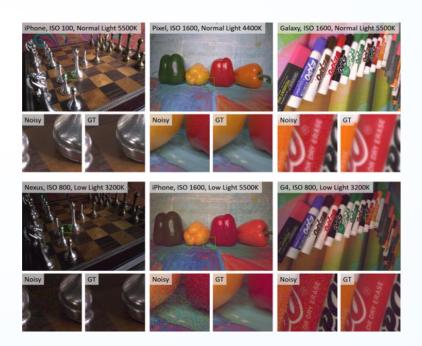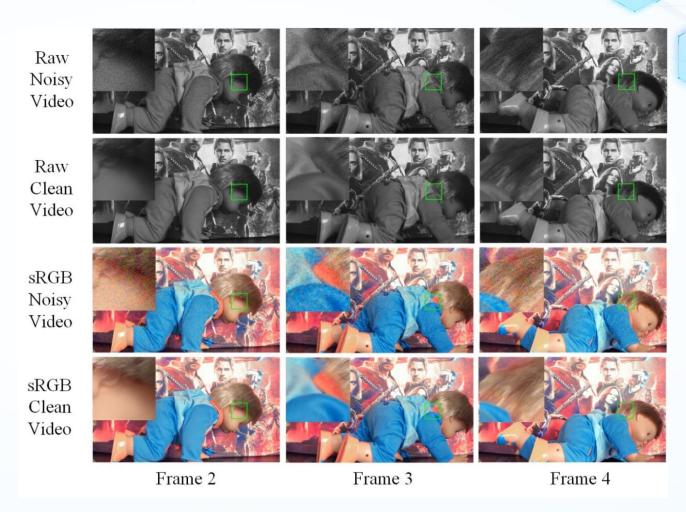

DND dataset
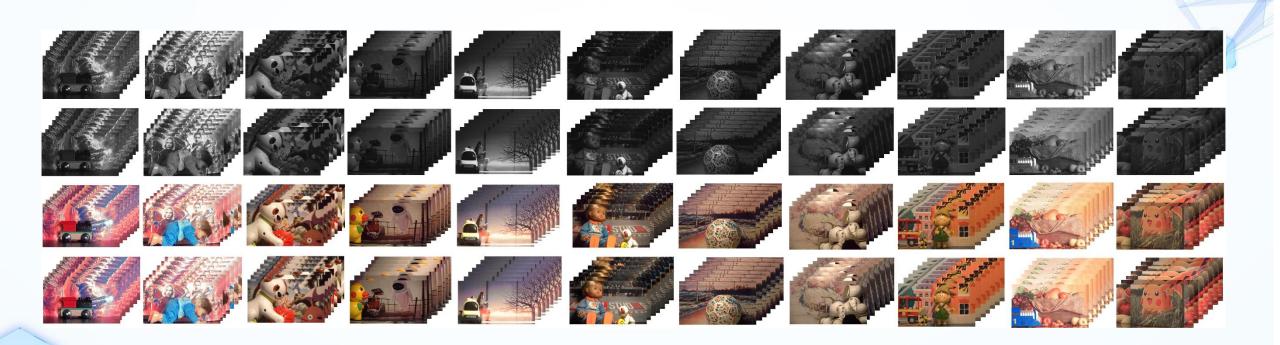
SIDD dataset

2 数据集构建

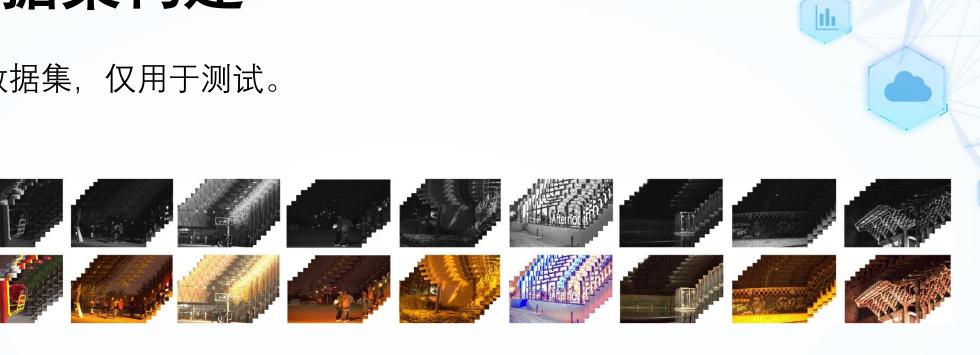□ 困难

无法同步拍摄带噪-干净帧

□ 解决方法

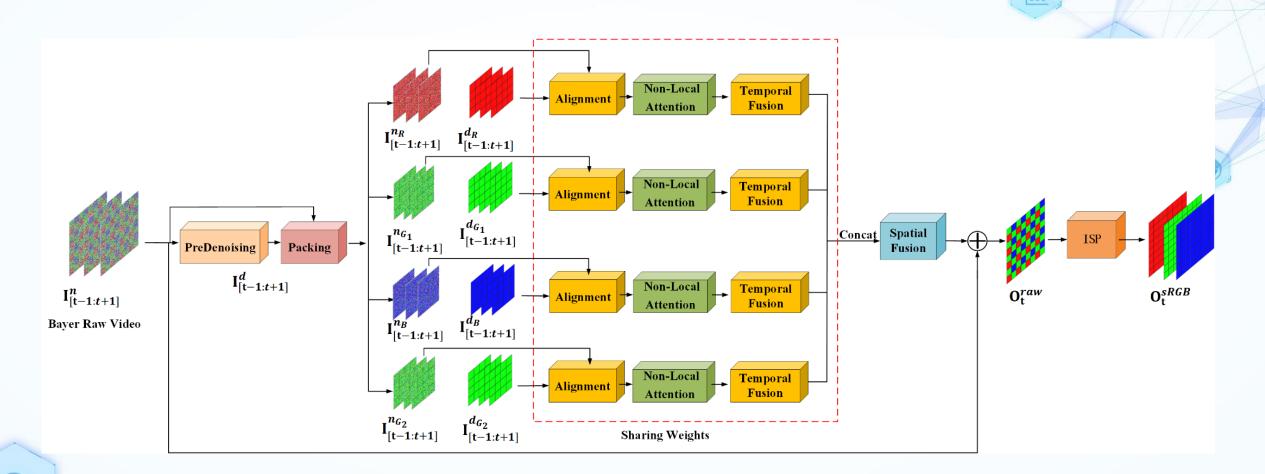定格动画拍摄法

2 数据集构建

□ 共拍摄55组室内数据集，包含11个场景，5种ISO设置

2 数据集构建

□ 室外数据集，仅用于测试。
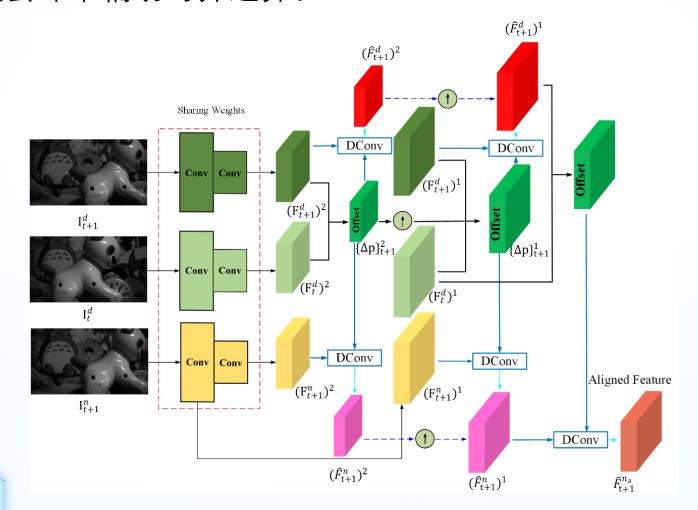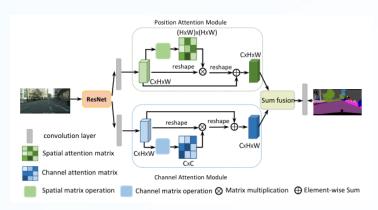
The framework of proposed RViDeNet.
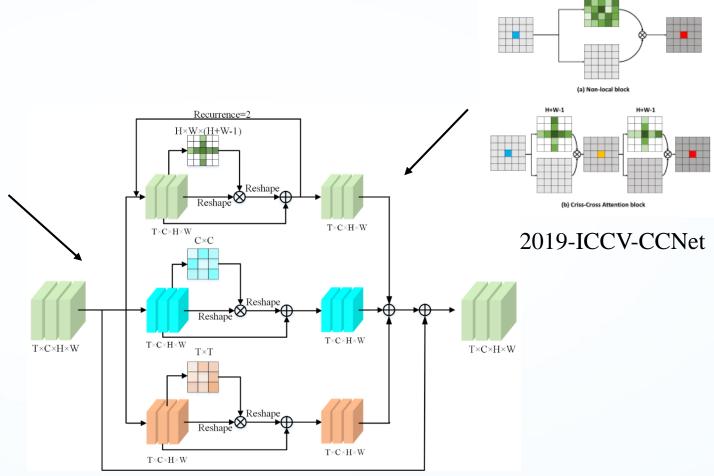
□ 鉴于噪声影响alignment, 借鉴BM3D两阶段去噪思想,
利用预去噪来辅助对齐运算。

2019-CVPR-DANet

2019-ICCV-CCNet

Non-local Attention

3 所提方法

□ 损失函数

$$
\begin{aligned}
\mathcal{L} =& \mathcal{L}_{\text{rec}} + \lambda \mathcal{L}_{\text{tmp}}, \\
\mathcal{L}_{\text{rec}} =& \|I_t^{\text{raw}} - O_t^{\text{raw}}\|_1 + \beta \|I_t^{\text{sRGB}} - O_t^{\text{sRGB}}\|_1, \\
\mathcal{L}_{\text{tmp}} =& \|\hat{O}_t^{\text{raw}_1} - \hat{O}_t^{\text{raw}_2}\|_1, \\
& + \gamma(\|I_t^{\text{raw}} - \hat{O}_t^{\text{raw}_1}\|_1 + \|I_t^{\text{raw}} - \hat{O}_t^{\text{raw}_2}\|_1),
\end{aligned}
$$

实验结果
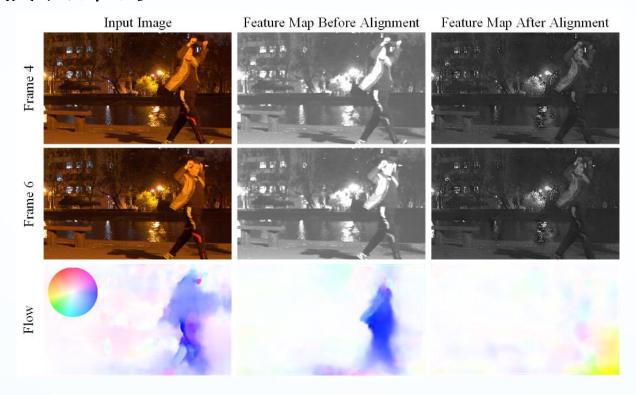
☐ 消融实验

Ablation study for raw domain processing, packing, pre-denoising and non-local attention modules. The PSNR (or SSIM) results are the averaging results on all the testing videos under different ISO settings ranging from 1600 to 25600.
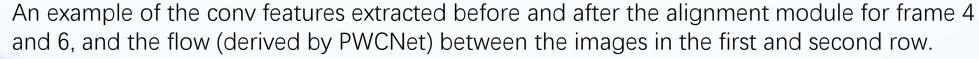
Raw domain		×	✓	✓	✓	✓
Packing		×	×	✓	✓	✓
Pre-denoising		×	×	×	✓	✓
Non-local attention		×	×	×	×	✓
Raw	PSNR	-	43.84	43.84	43.88	**43.97**
	SSIM	-	0.9866	0.9866	0.9871	**0.9874**
sRGB	PSNR	38.58	39.69	39.69	39.80	**39.95**
	SSIM	0.9703	0.9776	0.9778	0.9785	**0.9792**

实验结果

☐ 对齐模块评测

An example of the conv features extracted before and after the alignment module for frame 4 and 6, and the flow (derived by PWCNet) between the images in the first and second row.

Comparison with state-of-the-art methods on indoor dataset.
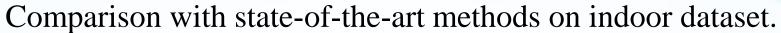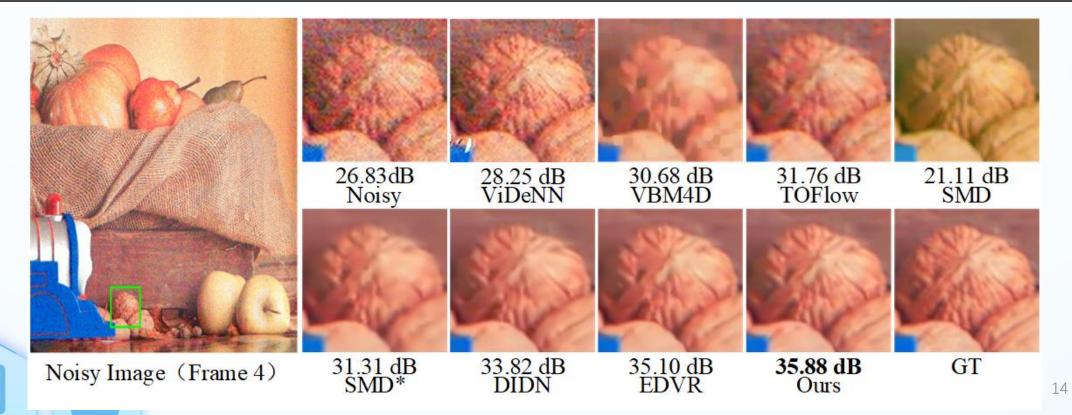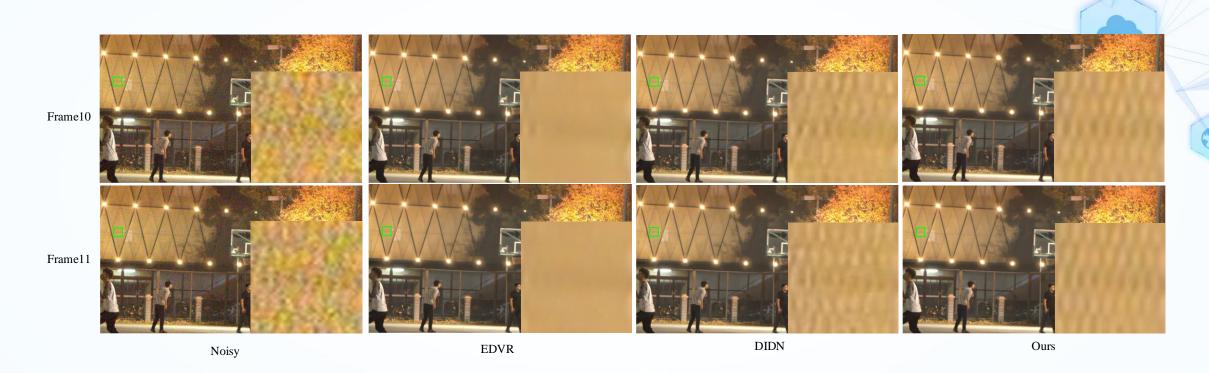
		Noisy	ViDeNN [11]	VBM4D [24]	TOFlow [43]	SMD [8]	SMD*	EDVR [35]	DIDN [44]	Ours⁻	Ours
Raw	PSNR	32.01	-	-	-	-	-	-	43.25	43.37	**43.97**
	SSIM	0.732	-	-	-	-	-	-	0.984	0.985	**0.987**
sRGB	PSNR	31.79	31.48	34.16	34.81	26.26	35.87	38.97	38.83	39.19	**39.95**
	SSIM	0.752	0.826	0.922	0.921	0.912	0.957	0.972	0.974	0.975	**0.979**

26.83dB Noisy · 28.25 dB ViDeNN · 30.68 dB VBM4D · 31.76 dB TOFlow · 21.11 dB SMD

Noisy Image（Frame 4）· 31.31 dB SMD* · 33.82 dB DIDN · 35.10 dB EDVR · **35.88 dB** Ours · GT

Frame10

Frame11

Noisy   EDVR   DIDN   Ours

Comparison on outdoor dataset.
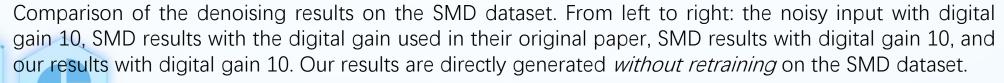
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Comparison of the denoising results on the SMD dataset. From left to right: the noisy input with digital gain 10, SMD results with the digital gain used in their original paper, SMD results with digital gain 10, and our results with digital gain 10. Our results are directly generated *without retraining* on the SMD dataset.

5 总结

☐ A benchmark video denoising dataset

☐ An efficient video denoising network-RViDeNet

☐ State-of-the-art video denoising performance

谢 谢 观 看
THANK YOU