Neural Global Shutter

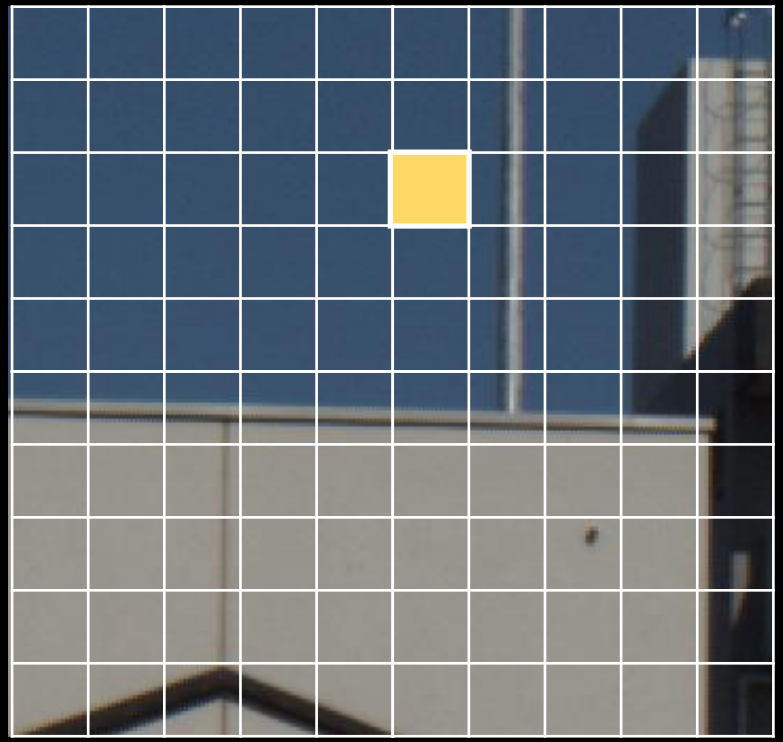
Learn to Restore Video from a Rolling Shutter Camera with Global Reset Feature

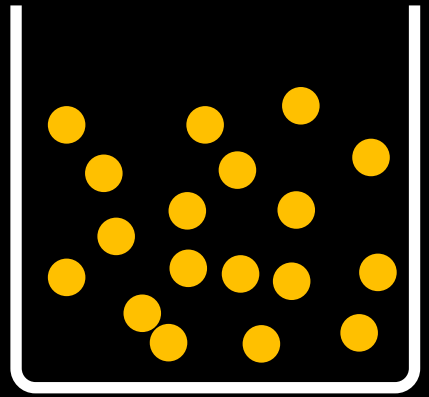
Zhixiang Wang Xiang Ji Jia-Bin Huang Shin'ichi Satoh

Xiao Zhou Yinqiang Zheng

How do image sensors record photon?

pixels





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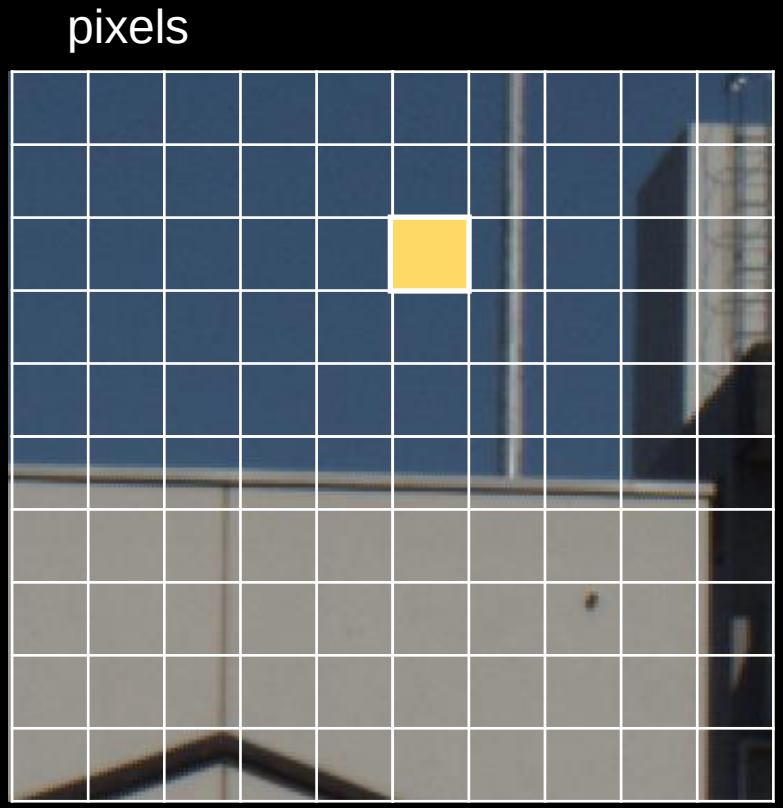

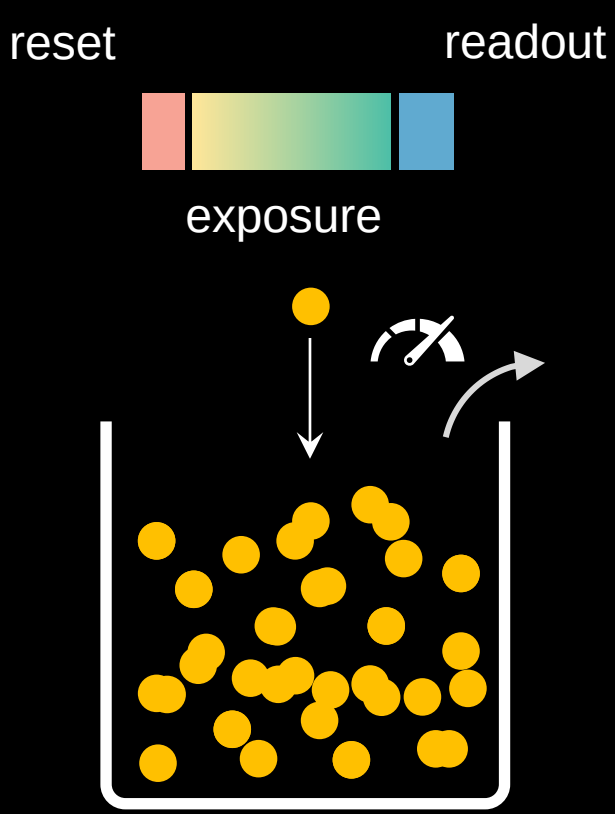

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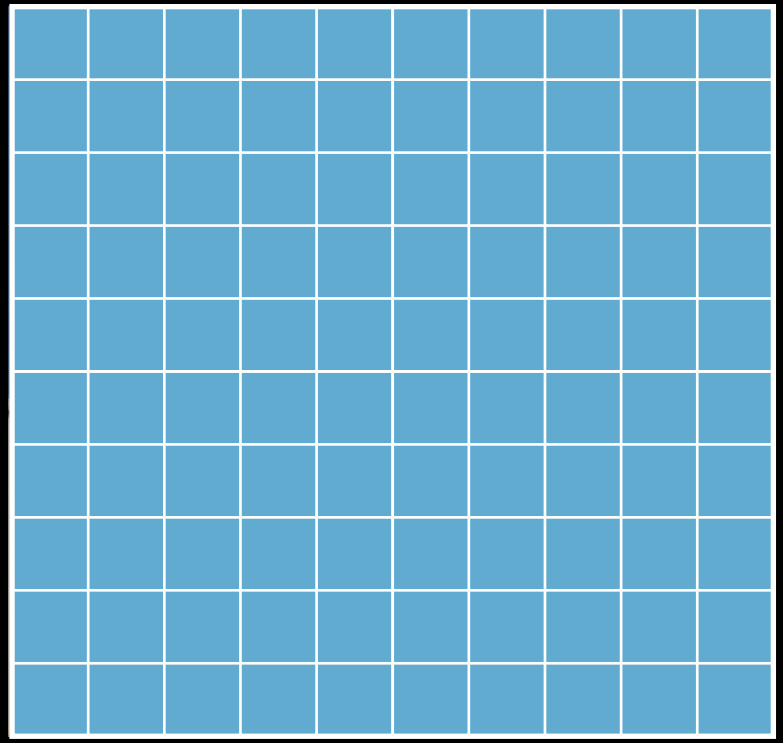
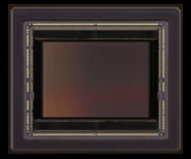
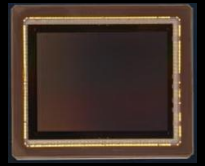
pixels



Two common shutter modes

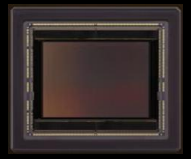


Global shutter

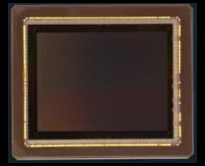


Rolling shutter

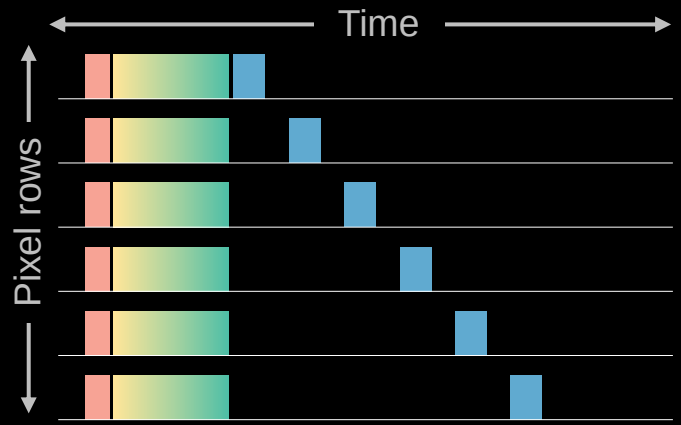
Two common shutter modes



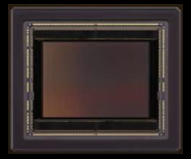
Global shutter



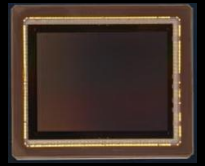
Rolling shutter



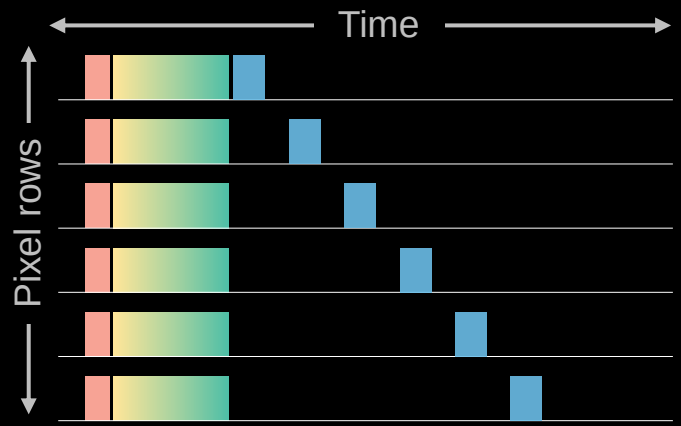
Two common shutter modes

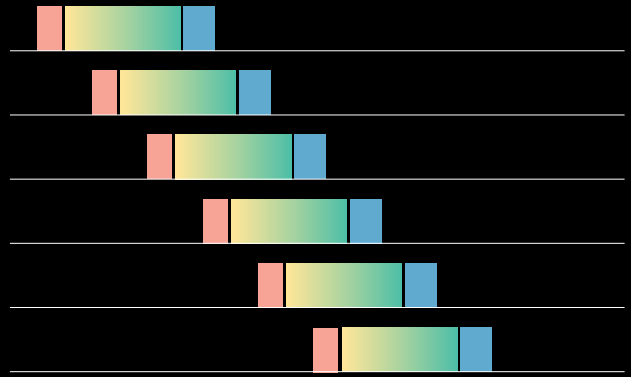


Global shutter

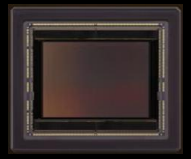


Rolling shutter

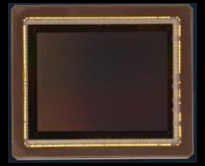




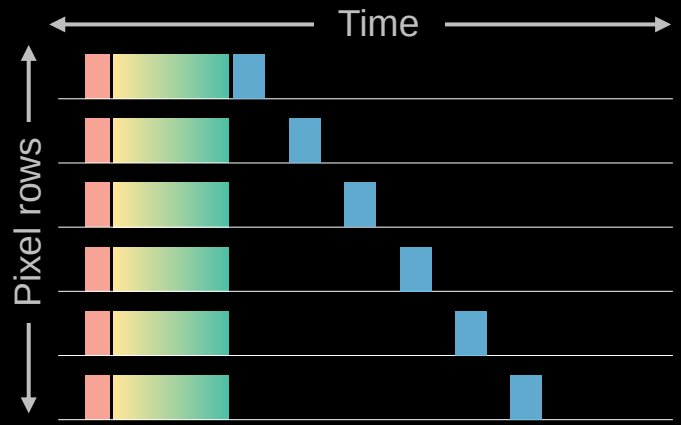
Two common shutter modes

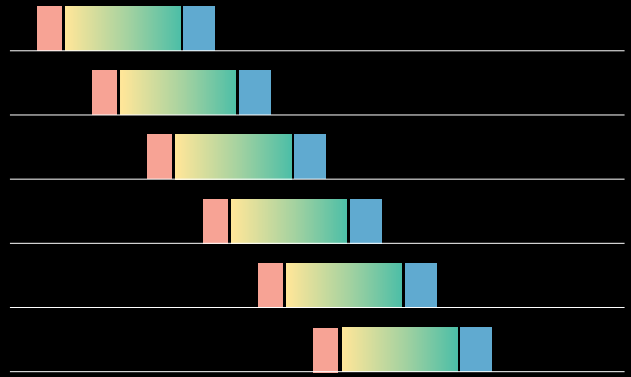


Global shutter



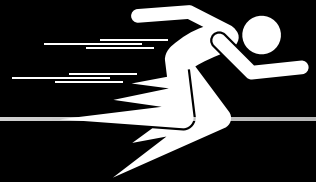
Rolling shutter [most used]





Advantages: *low cost, low* noise, *high* sensitivity and *high* frame rate

The problem of rolling shutter

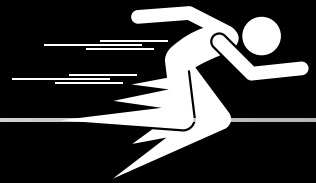


Geometry distortion

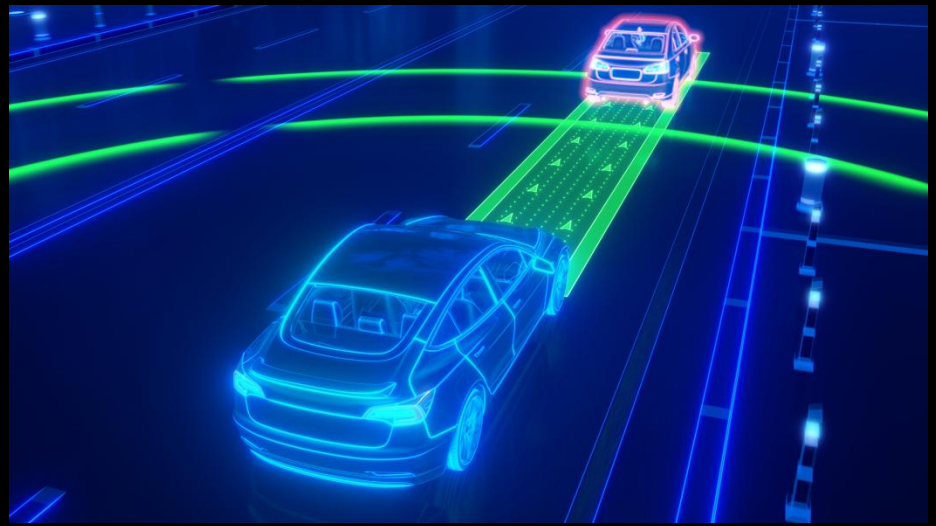
global shutter

rolling shutter

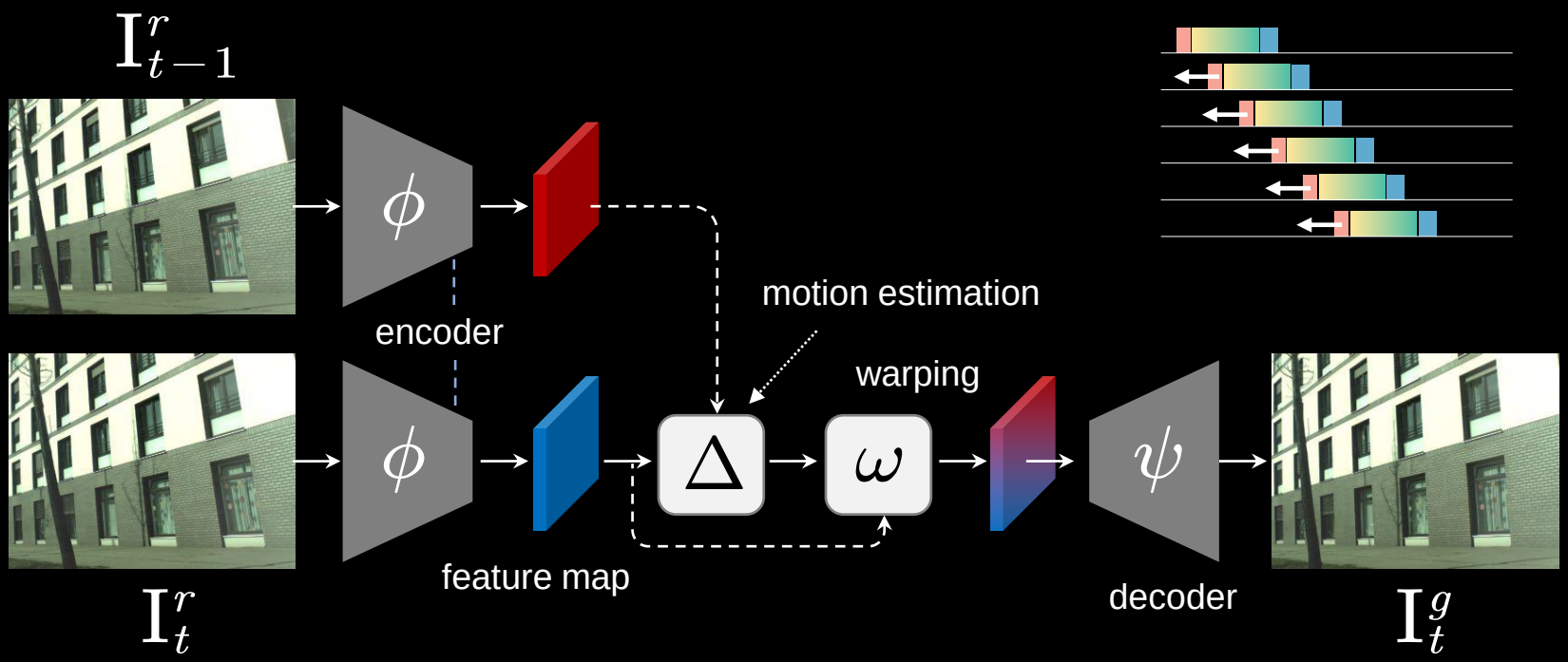
The problem of rolling shutter



Example: automatic car



Correcting rolling shutter distortion



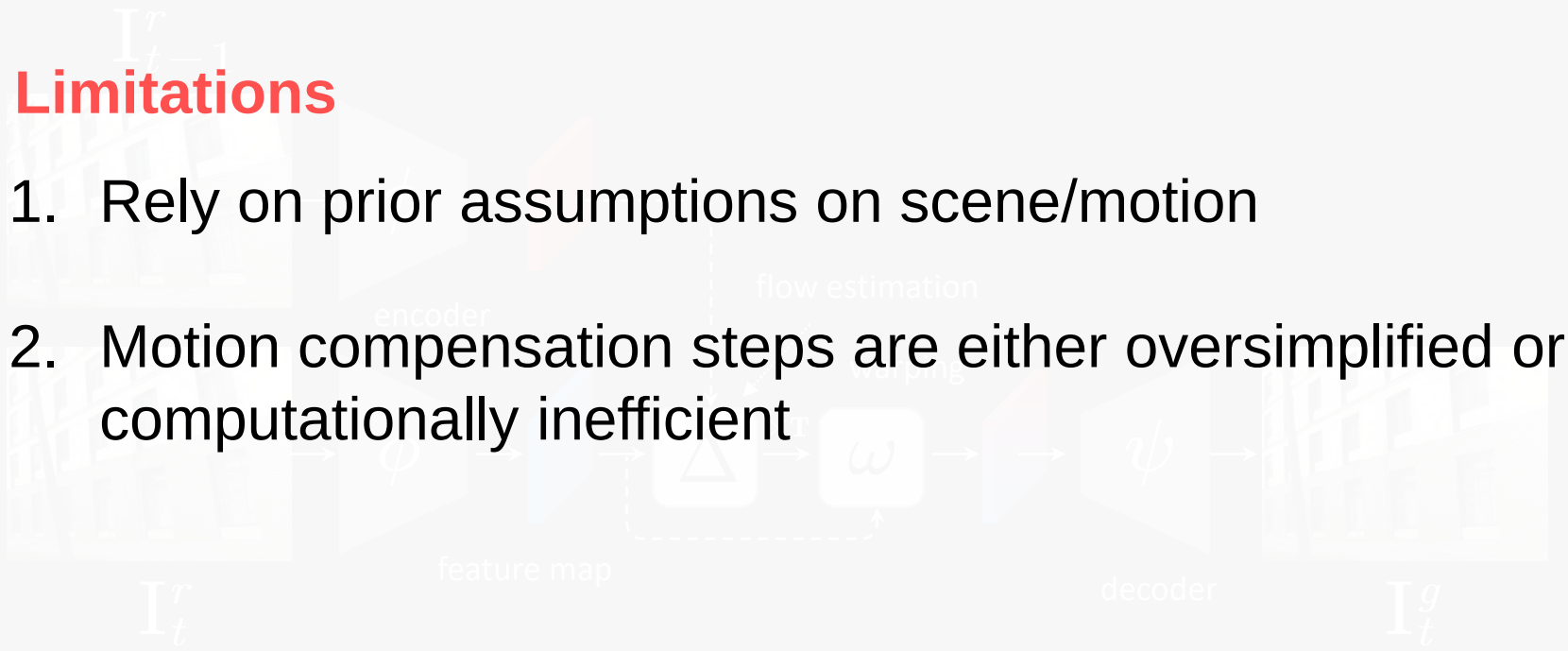
[Liu+ CVPR, 2020]

Correcting rolling shutter distortion

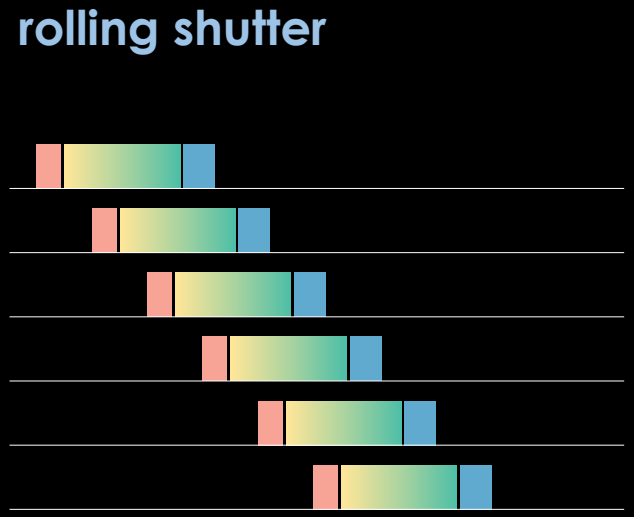
Limitations

1. Rely on prior assumptions on scene/motion

2. Motion compensation steps are either oversimplified or computationally inefficient

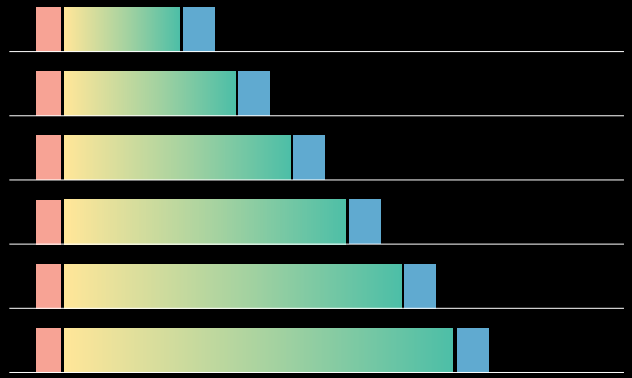


Our finding – a widely ignored feature



Our finding – a widely ignored feature

rolling shutter with global reset



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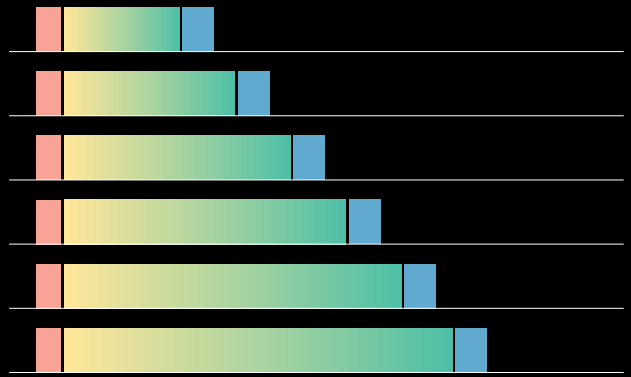
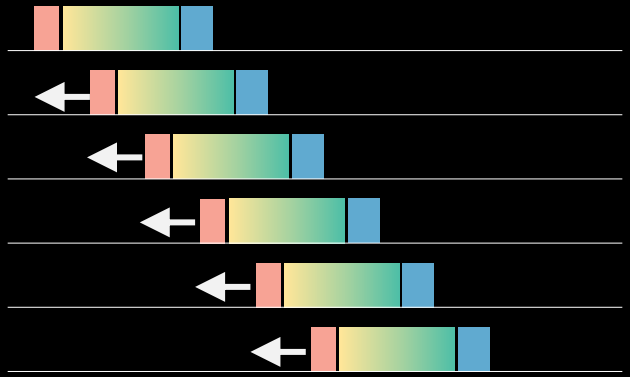
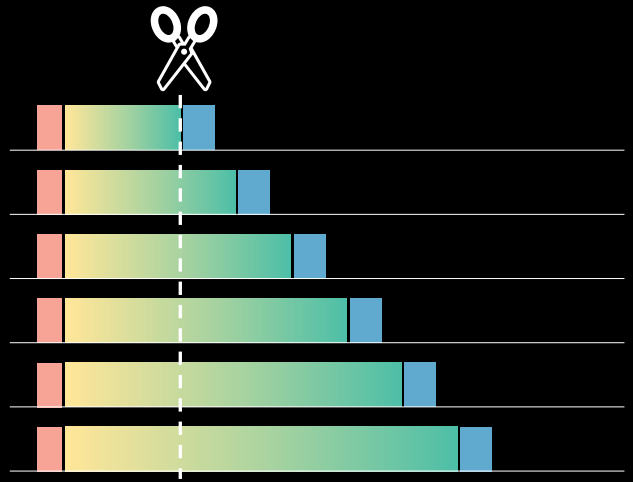


Our idea – alleviating RSGR distortion

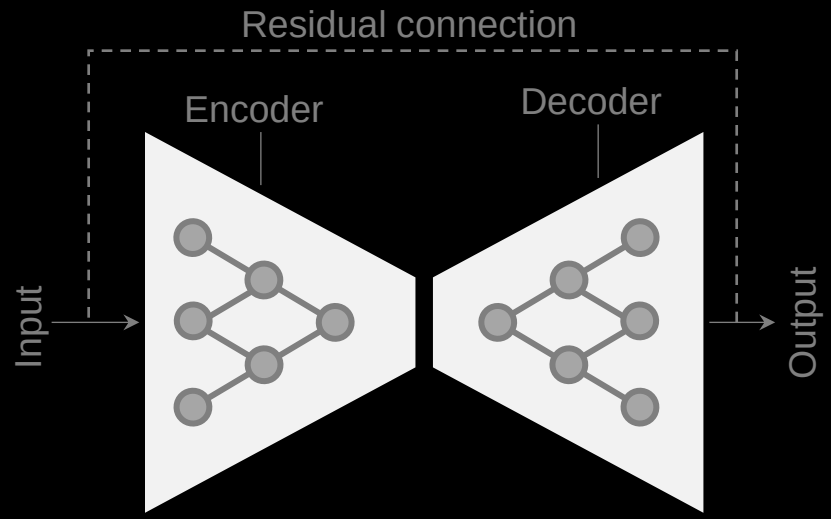


Conventional RS correction



Ours: deblur-like

Our method – model



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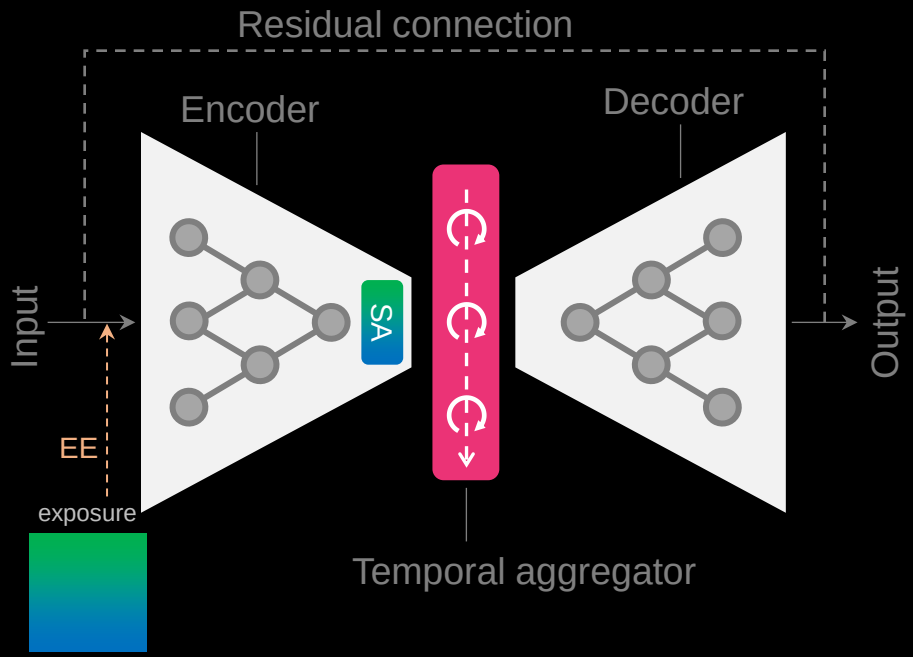
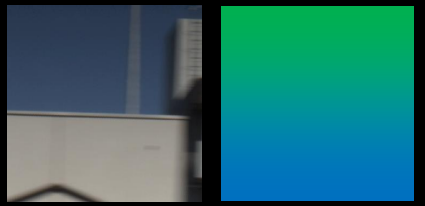
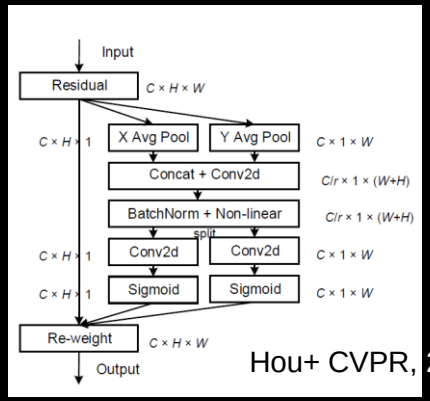


Exposure encoding

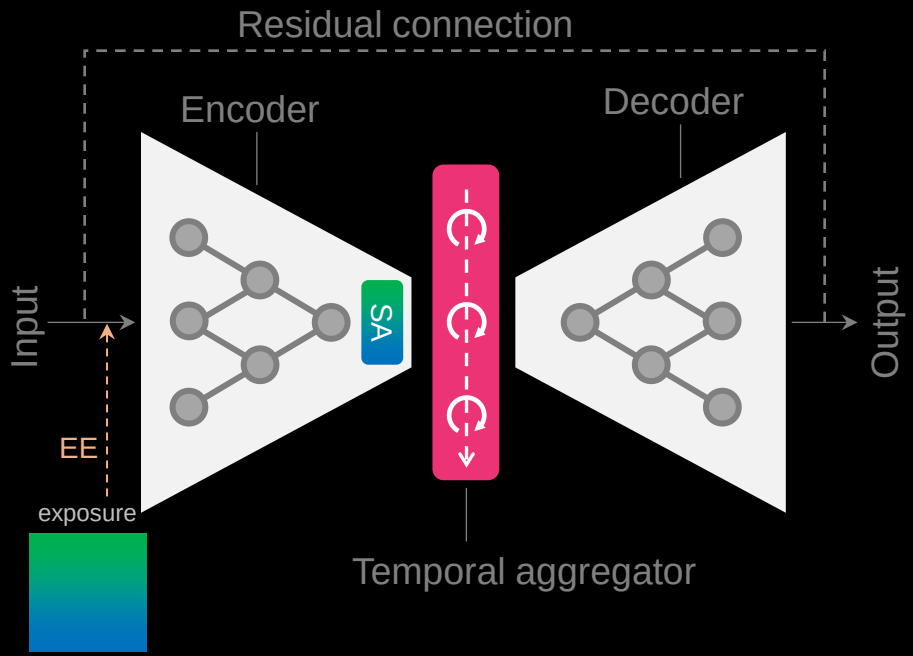


Spatial attention

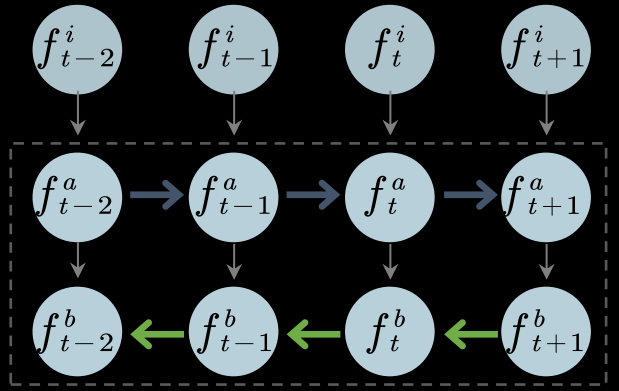


Hou+ CVPR, 2021]

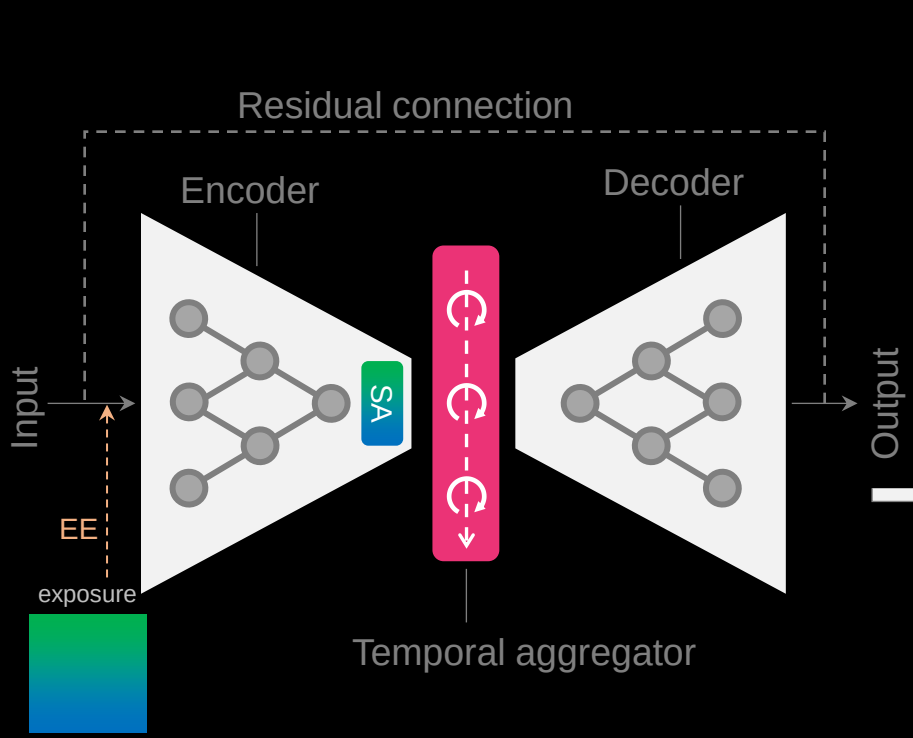
Our method – model

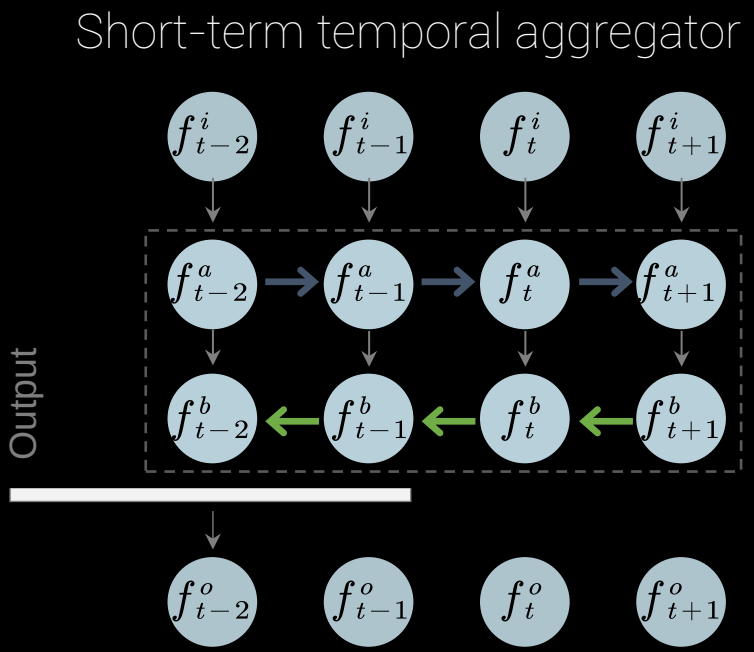


Long-term temporal aggregator

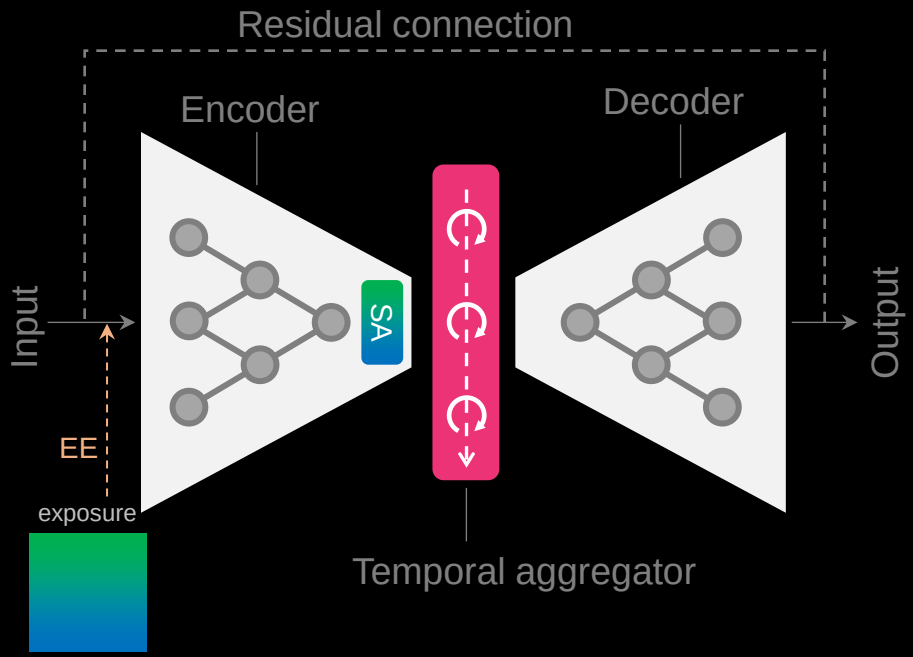


Our method – model

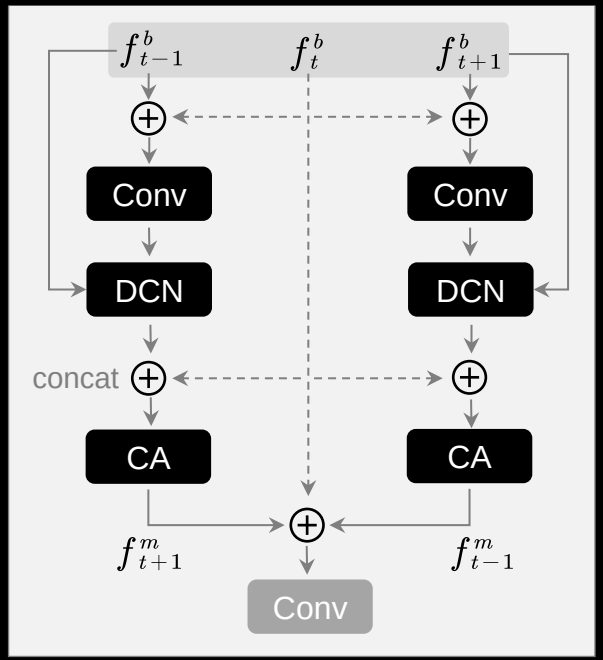




Our method – model



Short-term temporal aggregator



Our method – data acquisition

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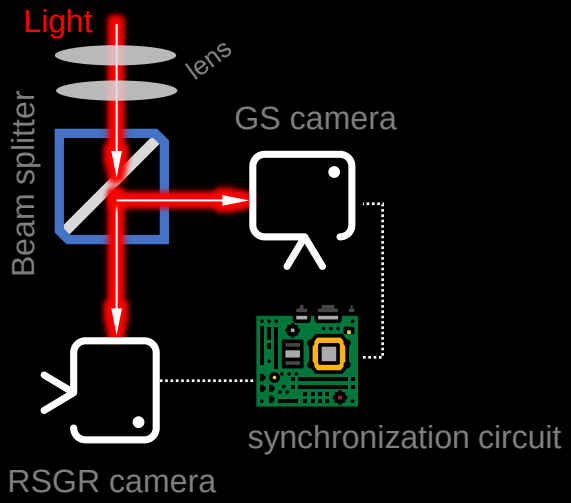
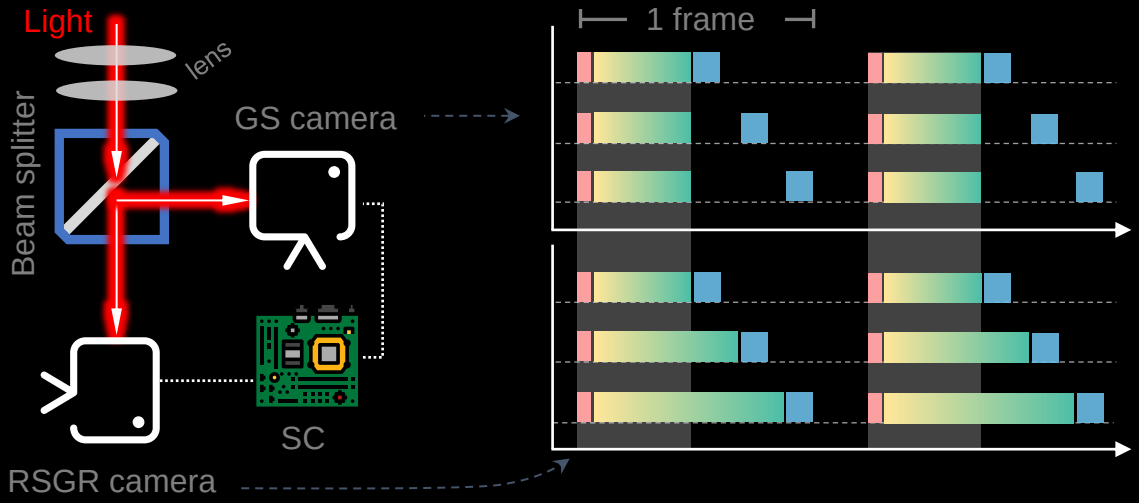


Our method – data acquisition



Results – video

input

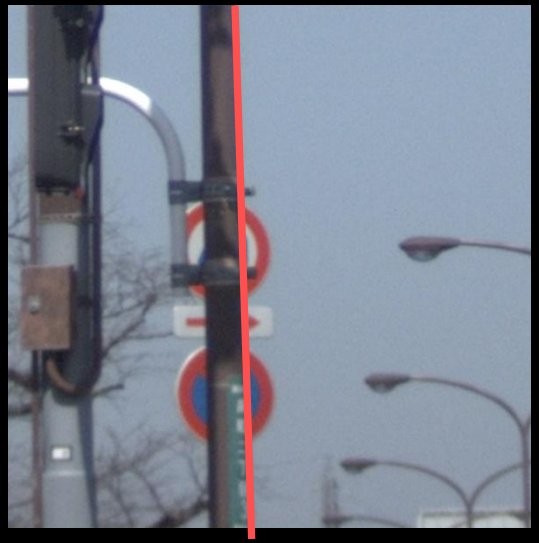
output

ground-truth

Results – sample frame

input

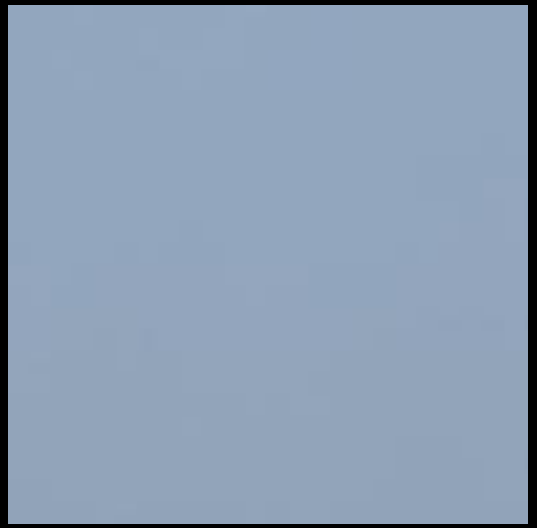
output



ground-truth

Results – zoom in

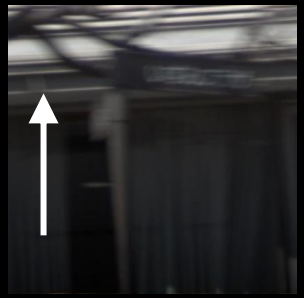
input



output

ground-truth

Results – qualitative comparisons


input


deblurGAN-v2


SRN


ours-noT


STRCNN


DBN


IFIRNN


ESTRNN


DSUR


JCD

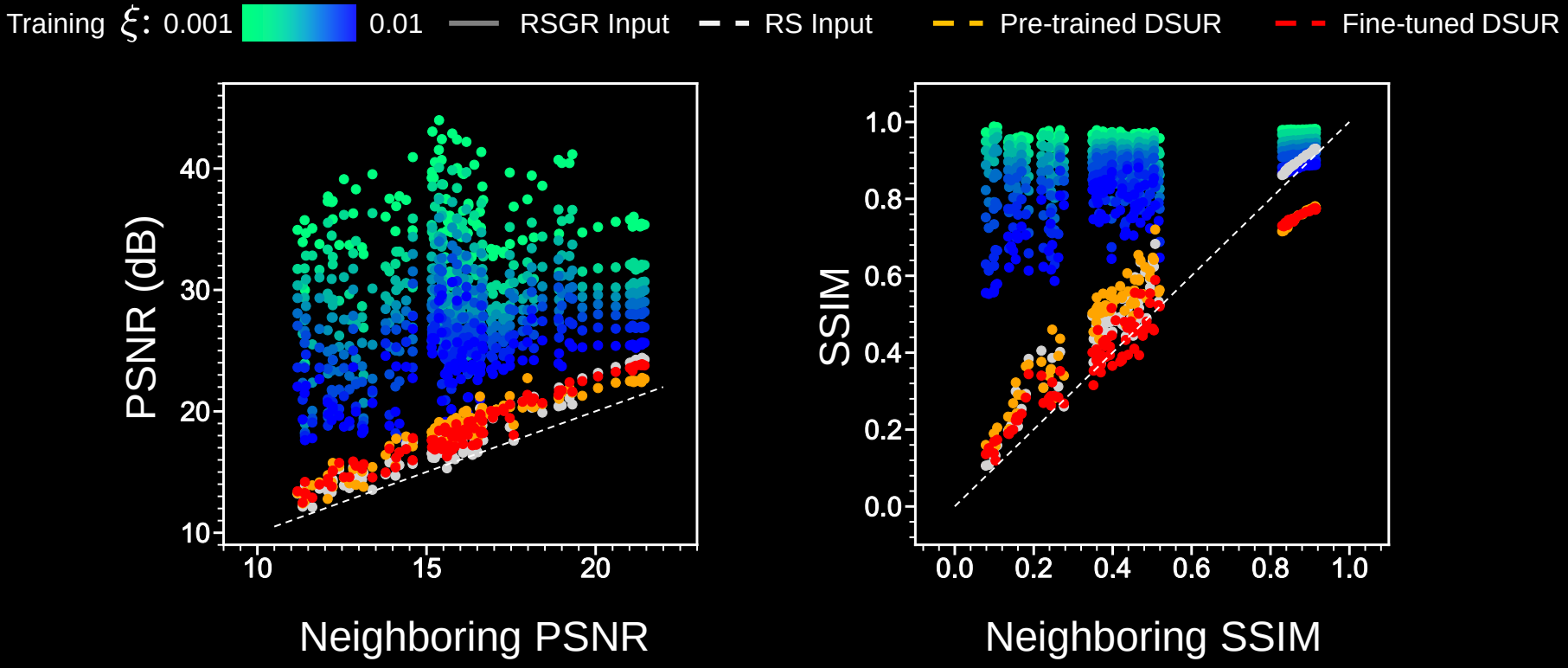
ours

ground-truth

Results – quantitative comparisons

	Set-I				Set-II			
Method	Full	Top	Middle	Bottom	Full	Top	Middle	Bottom
Input	18.95 / 0.75	25.32 / 0.82	21.56 / 0.81	16.36 / 0.63	17.82 / 0.73	23.64 / 0.77	21.45 / 0.77	15.54 / 0.66
deblurGANv2	19.97 / 0.73	21.54 / 0.75	23.73 / 0.77	18.17 / 0.69	18.34 / 0.69	20.14 / 0.69	22.14 / 0.71	17.28 / 0.66
SRN	26.87 / 0.86	26.12 / 0.83	27.08 / 0.85	29.59 / 0.89	25.05 / 0.81	24.32 / 0.79	25.65 / 0.81	27.02 / 0.83
STRCNN	24.88 / 0.85	24.27 / 0.83	25.33 / 0.85	27.54 / 0.88	22.59 / 0.81	22.99 / 0.79	23.46 / 0.81	23.66 / 0.83
DBN	26.49 / 0.87	26.50 / 0.85	26.66 / 0.87	28.47 / 0.89	22.57 / 0.81	23.24 / 0.80	23.81 / 0.81	23.24 / 0.82
IFIRNN	28.01 / 0.89	27.20 / 0.88	28.35 / 0.89	29.21 / 0.90	25.17 / 0.82	24.77 / 0.80	25.62 / 0.81	26.94 / 0.84
ESTRNN	25.85 / 0.89	26.67 / 0.88	30.16 / 0.90	25.19 / 0.89	22.72 / 0.83	23.42 / 0.81	26.03 / 0.83	22.86 / 0.83
DSUR	24.72 / 0.84	24.30 / 0.81	25.65 / 0.85	26.63 / 0.86	22.50 / 0.80	22.49 / 0.78	23.87 / 0.81	23.38 / 0.83
JCD	28.15 / 0.85	27.50 / 0.84	28.73 / 0.85	30.44 / 0.87	25.33 / 0.80	24.77 / 0.78	25.71 / 0.80	27.43 / 0.83
Ours-noT	27.56 / 0.85	26.23 / 0.83	27.55 / 0.85	31.55 / 0.88	25.37 / 0.80	24.74 / 0.77	25.65 / 0.79	27.29 / 0.82
Ours	**32.72 / 0.92**	**31.83 / 0.92**	**33.01 / 0.92**	**34.65 / 0.92**	**27.29 / 0.85**	**26.96 / 0.84**	**27.57 / 0.85**	**28.35 / 0.86**

Results – comparison with RS solution



[Liu+ CVPR, 2020]

Results – comparison with RS solution

Method	Time/frame
Zhuang+	400.00 sec
DSUR	0.43 sec
JCD	0.83 sec
Ours	0.04 sec

Thank you!

https://lightchaserx.github.io/

HOME PAGE

code and data

https://github.com/lightChaserX/neural-global-shutter