Decomposition in Image Restoration: Bad Weather, Nighttime, and Shadows

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Problem: Rain Streaks

Problem: Rain Veiling Effect

Problem: Fog/Haze

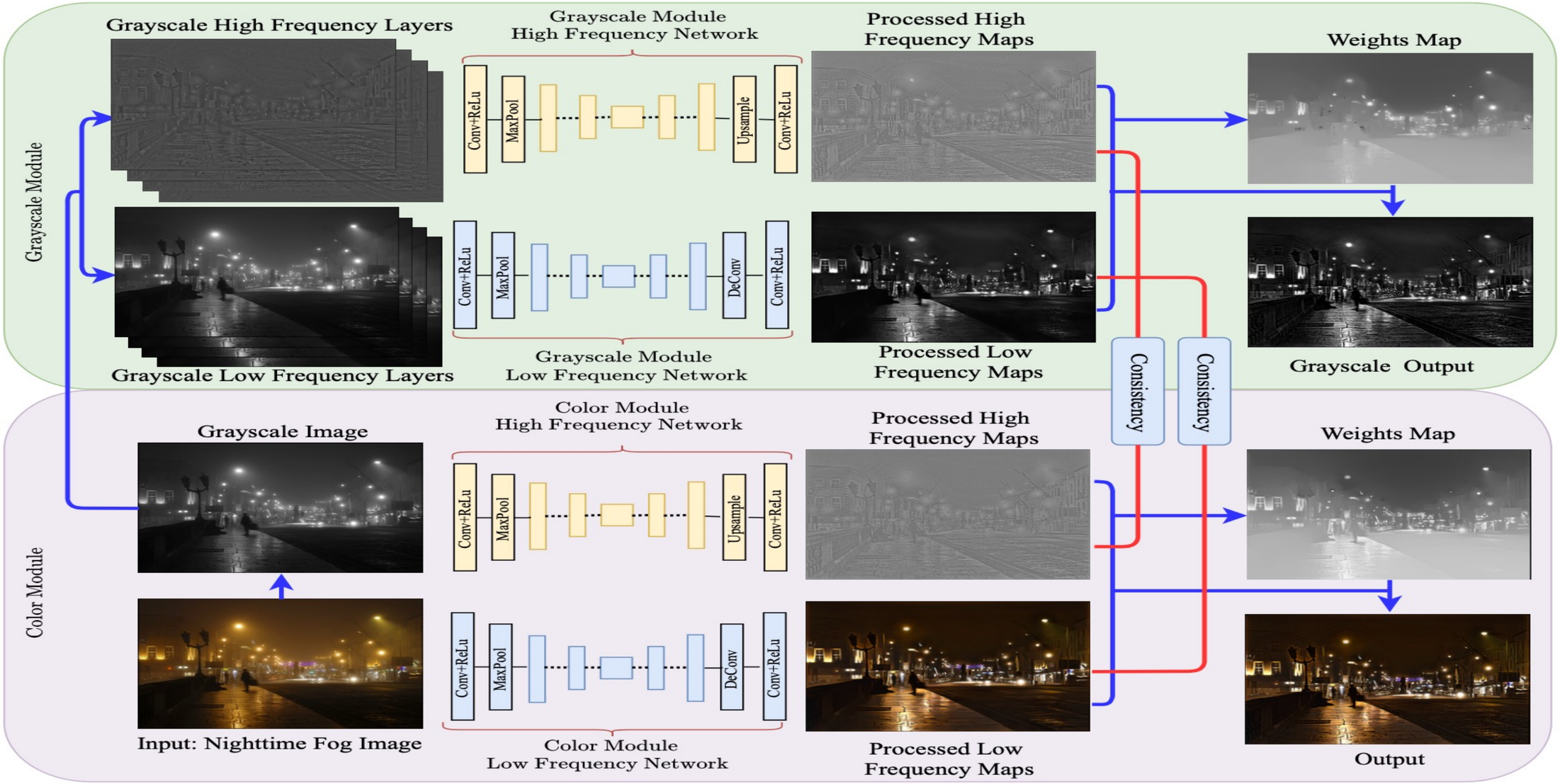
Problem: Night Glare/Floodlight

Problem: Night Glow

Problem: Shadows

Many of image restoration problems can be posed as image decomposition problem

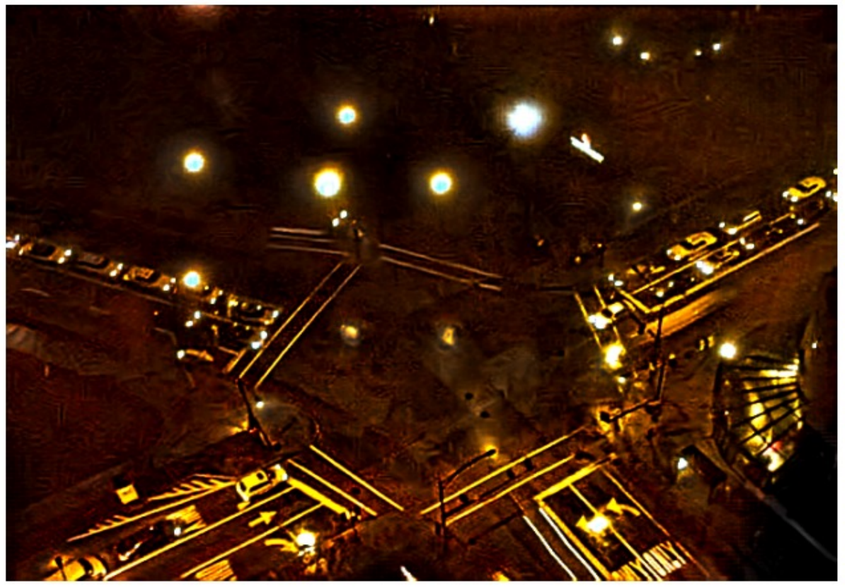
Decomposition Network: Night Glow (ECCV'20)



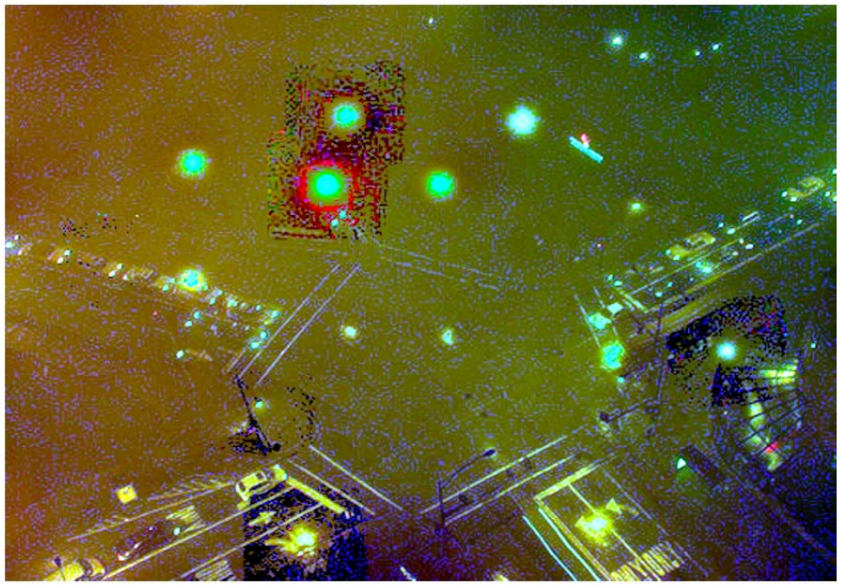

Input Image
GroundTruth
Our Result

Published in ECCV’20

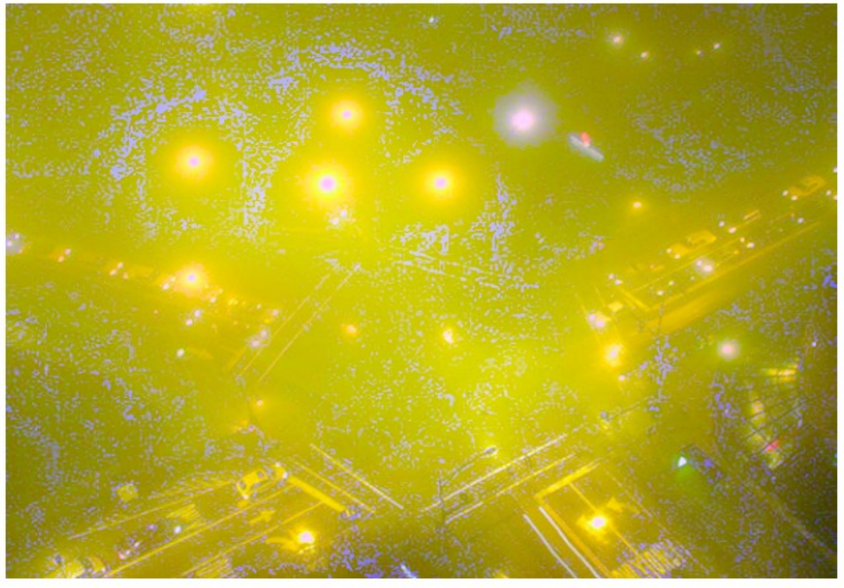
Input Image



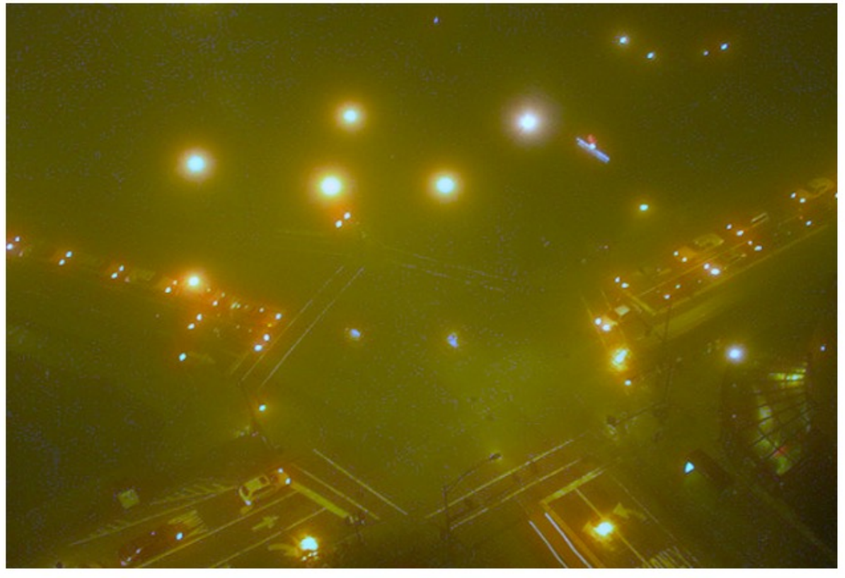
Our Result



Li et al.



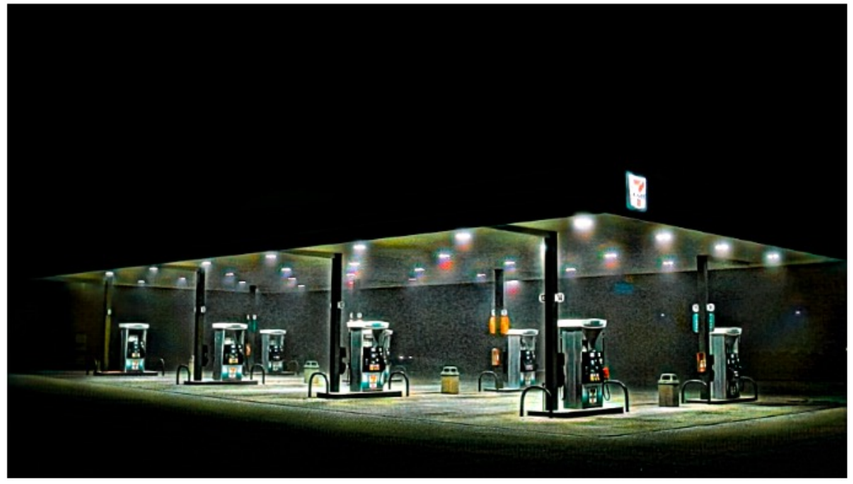
Zhang et al.



Ancuti et al.

Cycle GAN

Input Image



Our Result

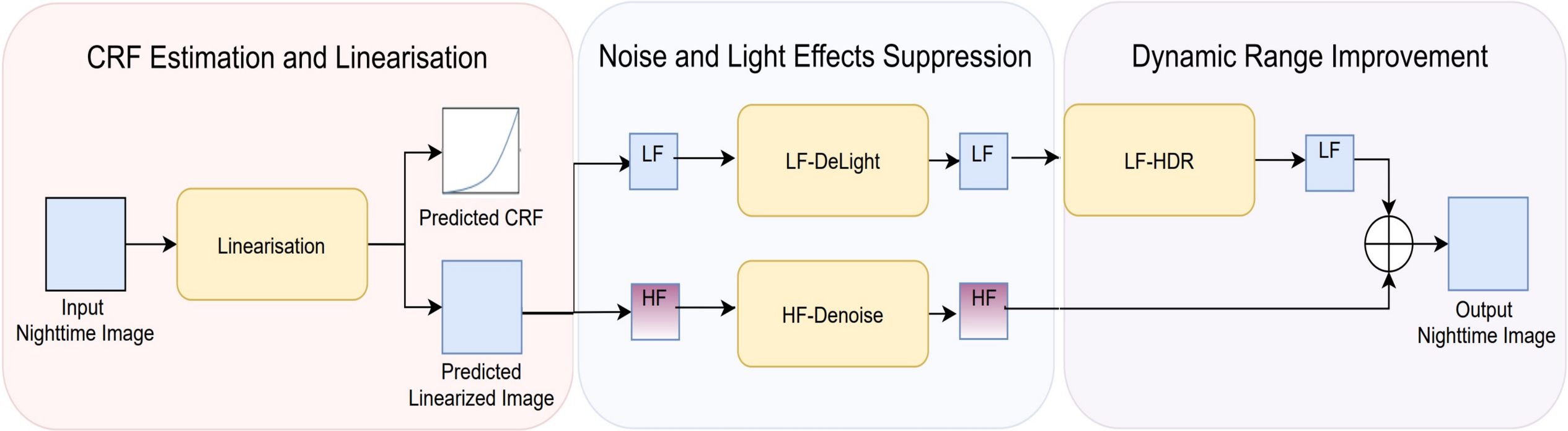
Li et al. [7]

Zhang et al. [12]

Ancuti et al. [2]

Cycle GAN [4]

Decomposition Network: Night Glare (CVPR'21)



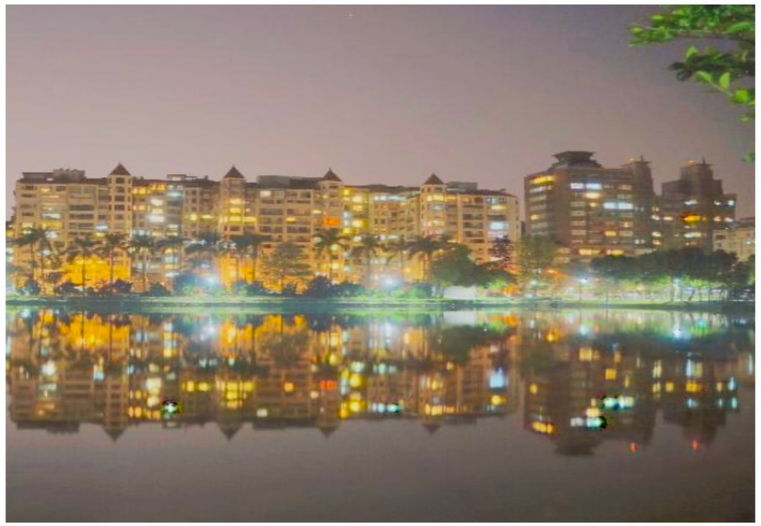
Results:

Input

Our Method

Ground-Truth

HDRCNN [2]



SingleHDR [10]

DrTMO [3]

Results:

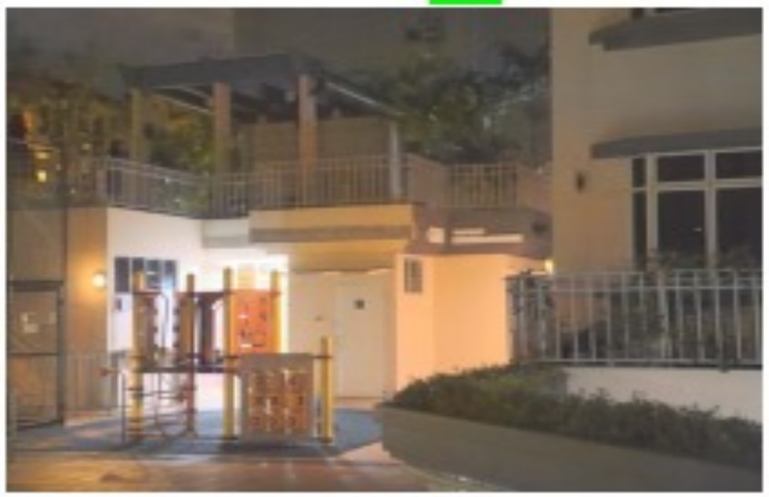
Input

Our Method

LIME [36]

ZeroDCE [35]

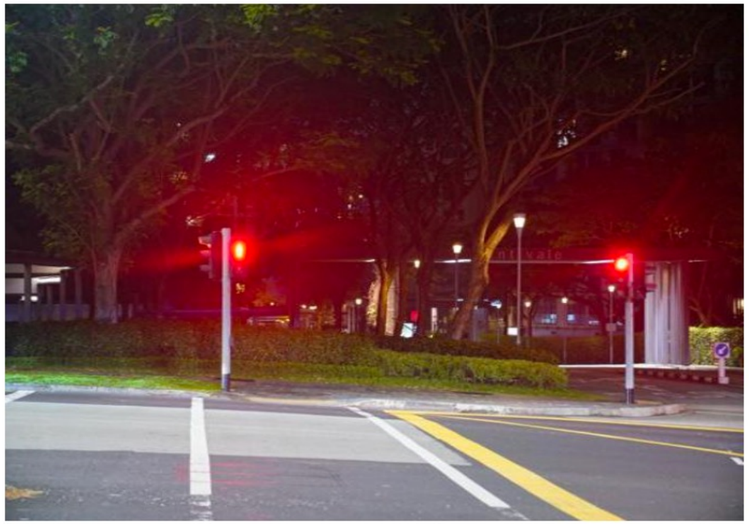
EnlightenGAN [45]



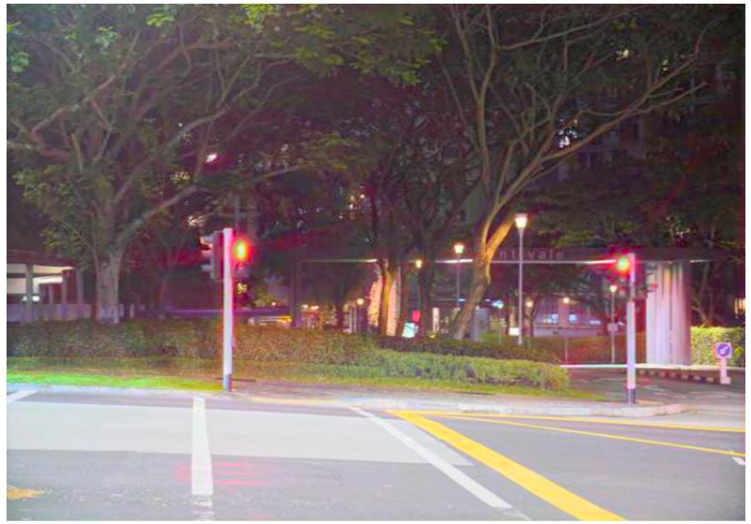
SingleHDR [69]

Results:

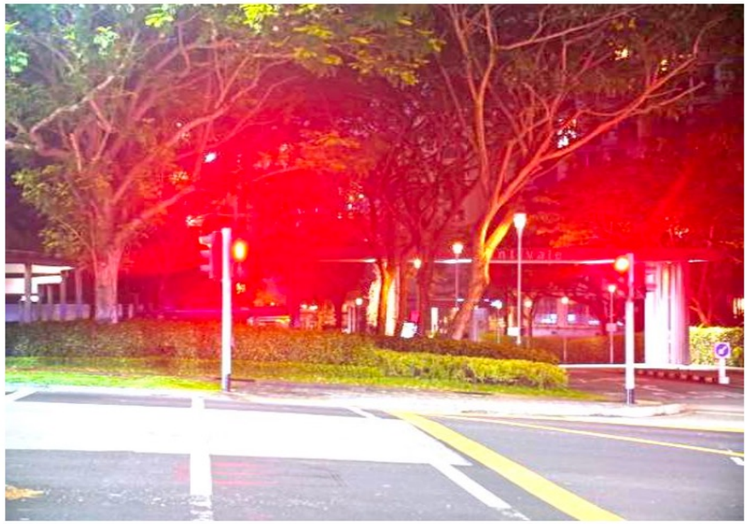
Results:



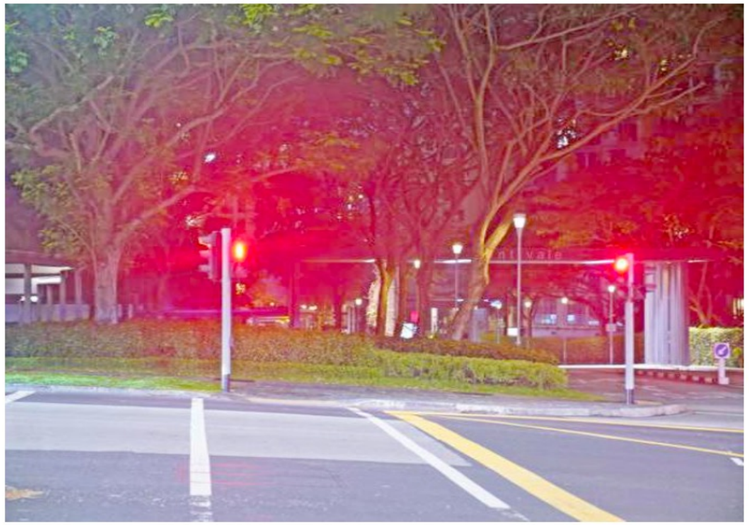
Input Image



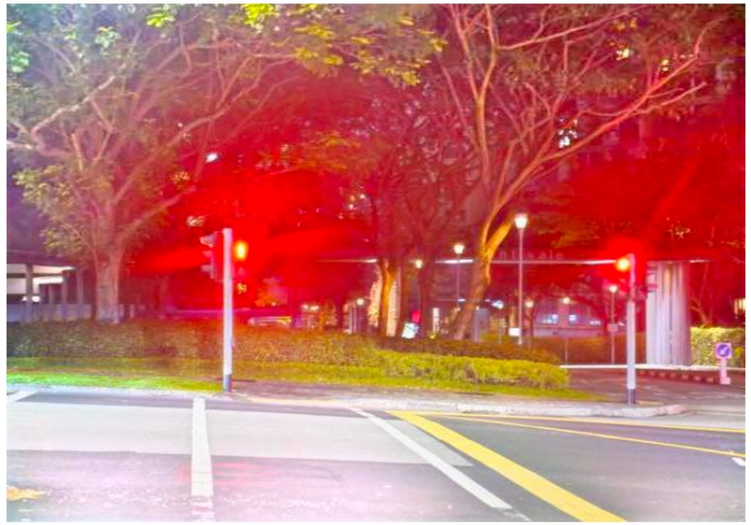
Our Method



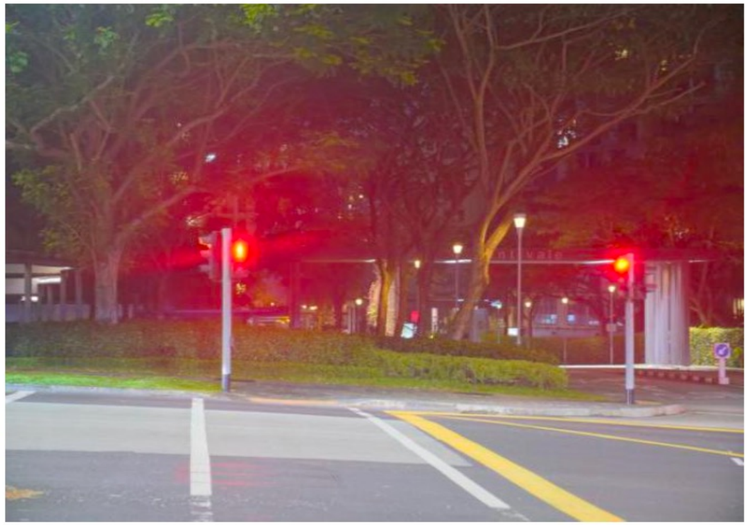
LIME [6]



ZeroDCE [5]



EnlightenGAN [7]



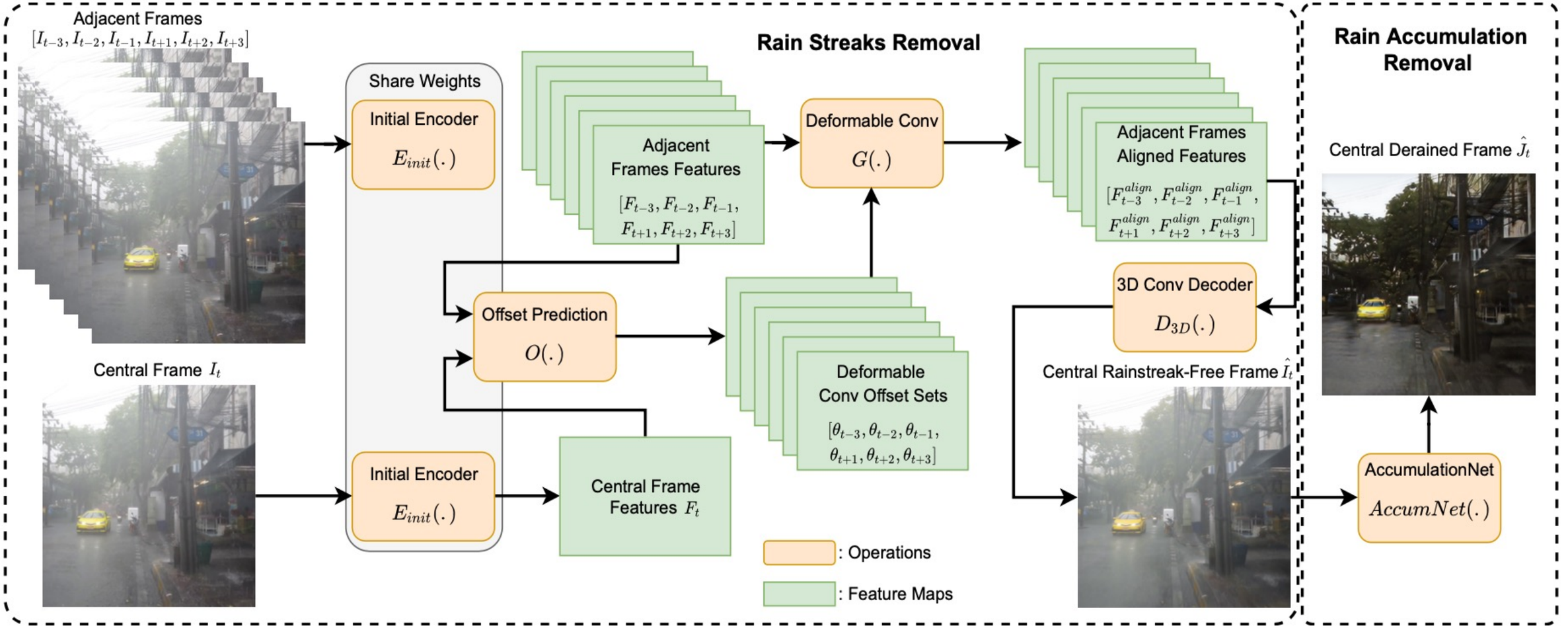
SingleHDR [10]

Results:

Results:

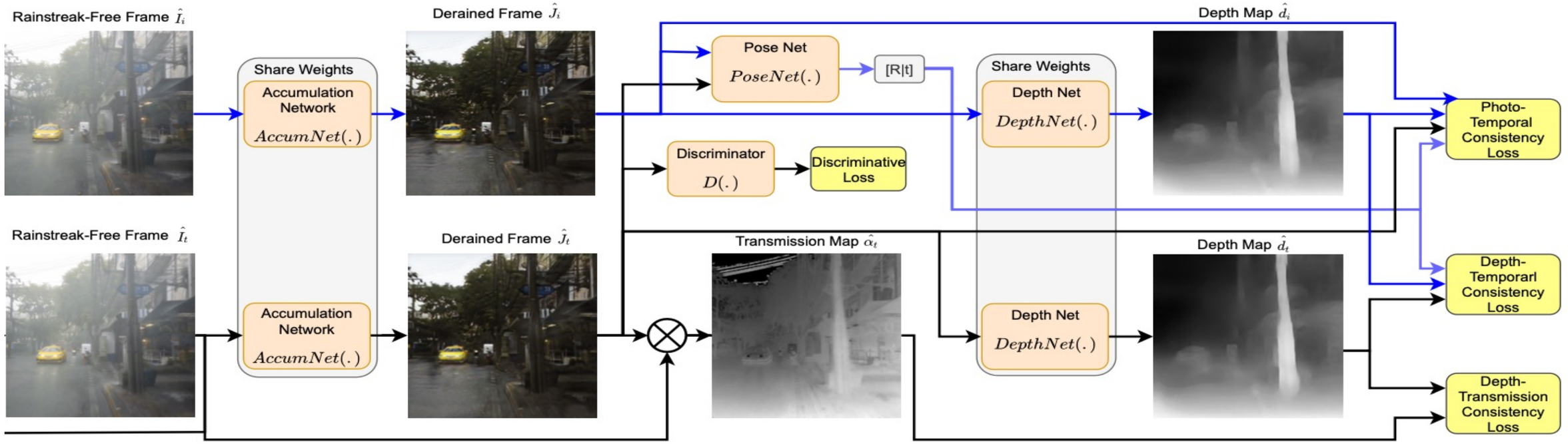
Input | **Our Method** | Zero-DCE [10] | EnlightenGAN [13] | SingleHDR [19]

Decomposition Network: Rain Streaks



Published in CVPR'21

Decomposition Network: Rain Veiling Effect



Published in CVPR'21

Results

Results

Input Image

Our Result

HRRestorer

DualFlow

Syn2Real

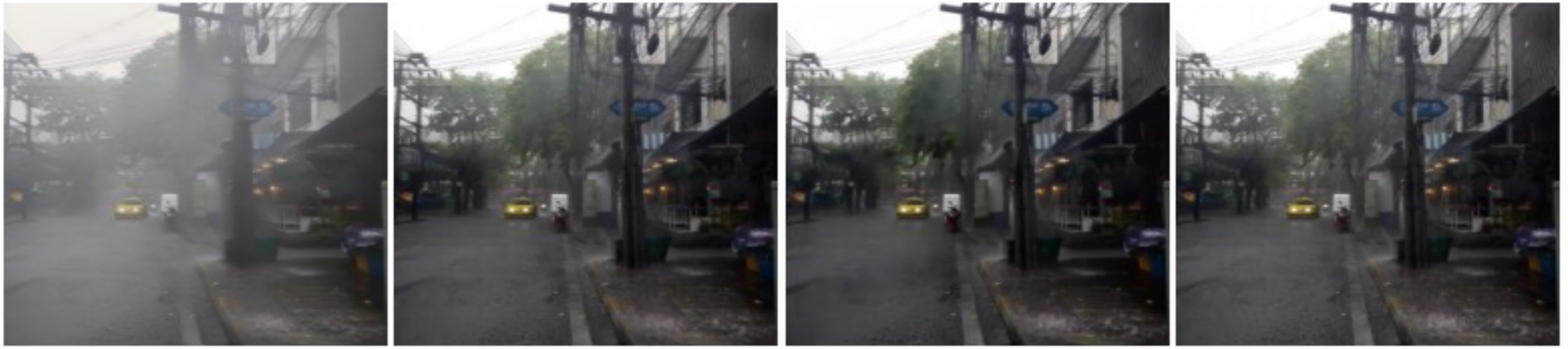
FastDeRain

MSPFN

SLDNet

Results

Input Image | **Our Result** | HRRestorer | DualFlow



Syn2Real | FastDeRain+MSBDN | MSPFN+MSBDN | SLDNet+MSBDN

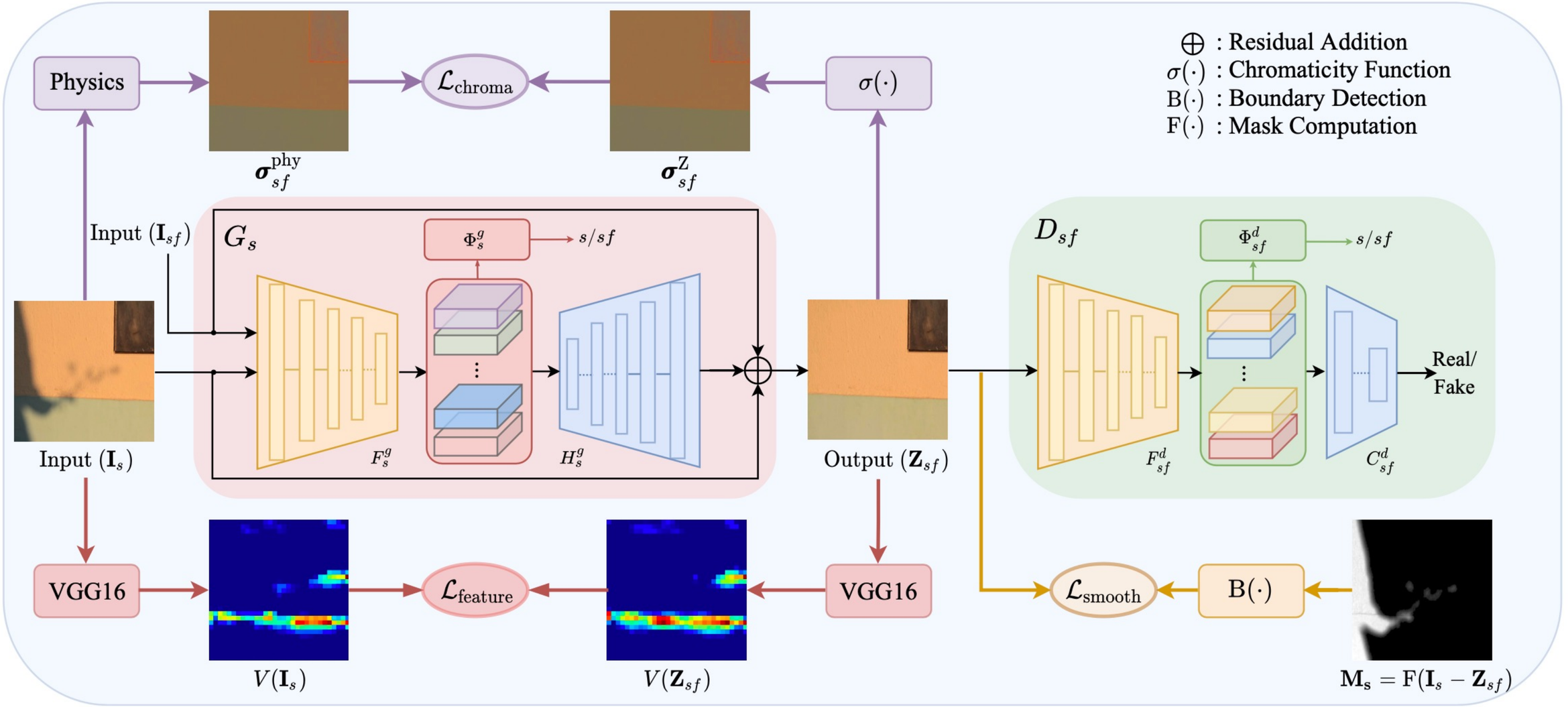
Decomposition in Shadow Removal (ICCV'21)

Introduction

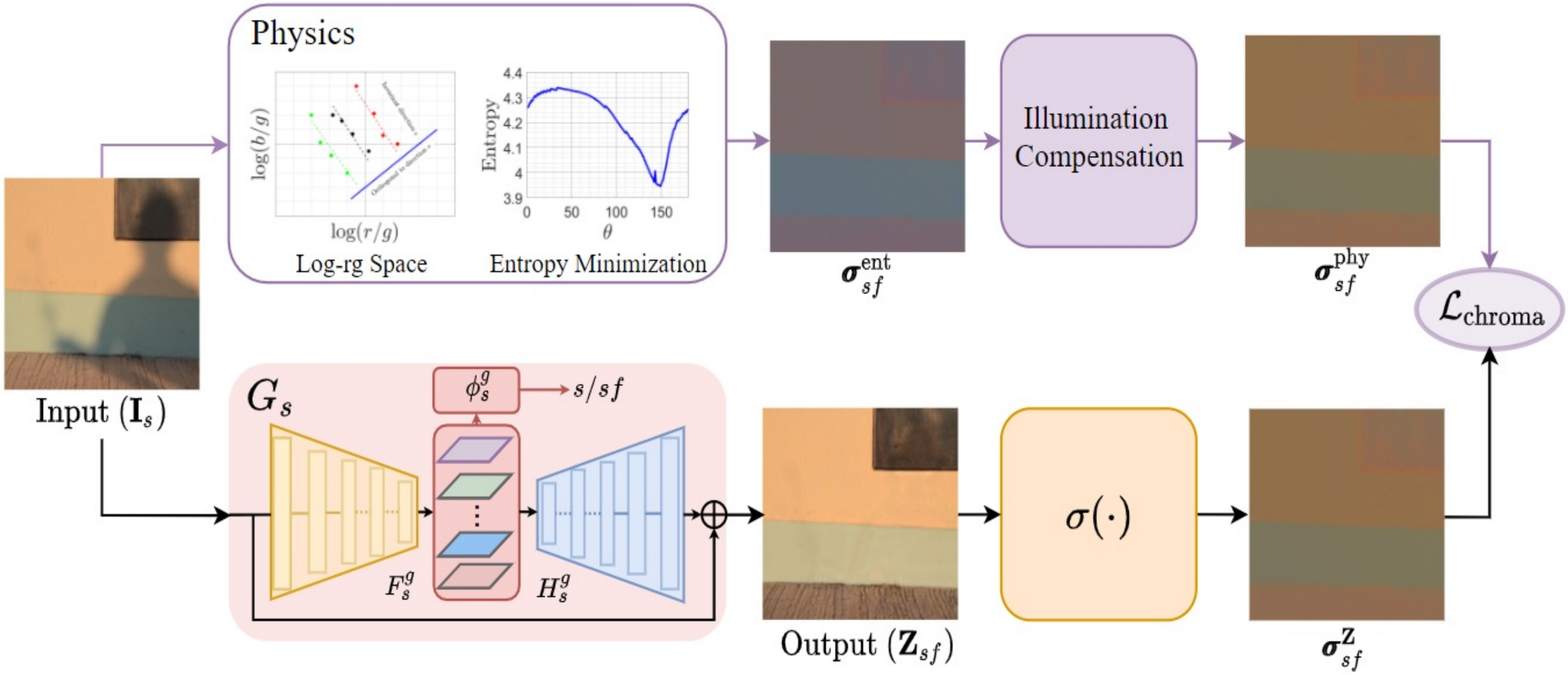
(a) Hard Shadow

(b) Soft Shadow

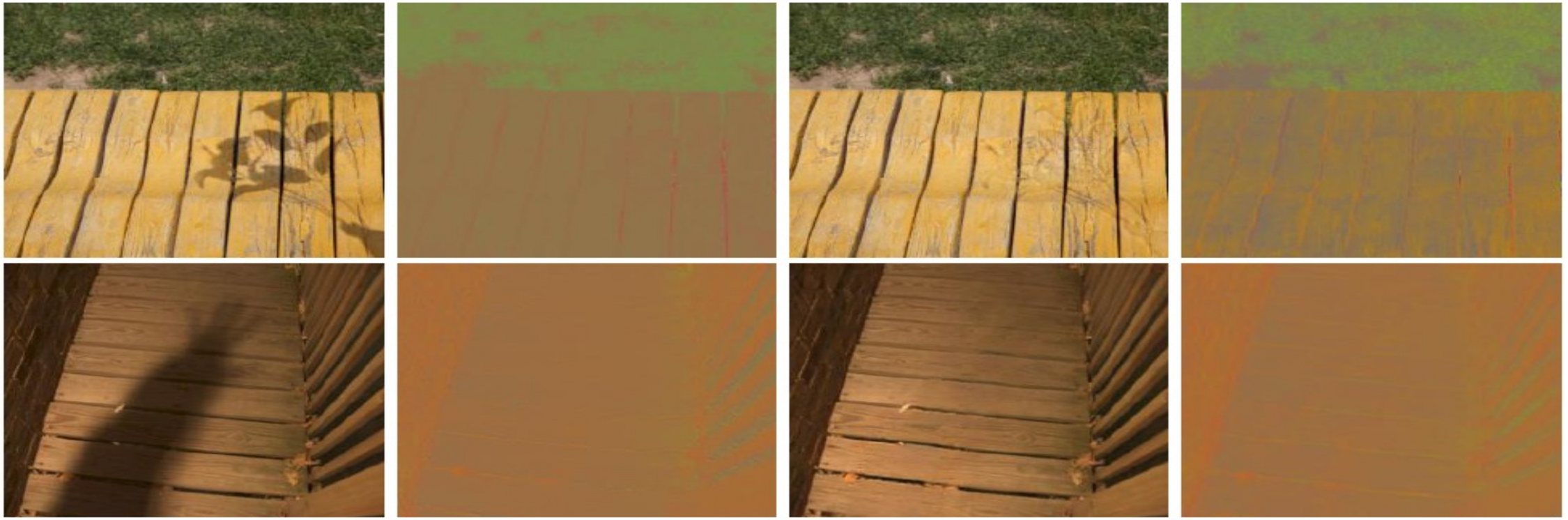
Network Architecture: DC-ShadowNet



Shadow-Free Chromaticity Loss



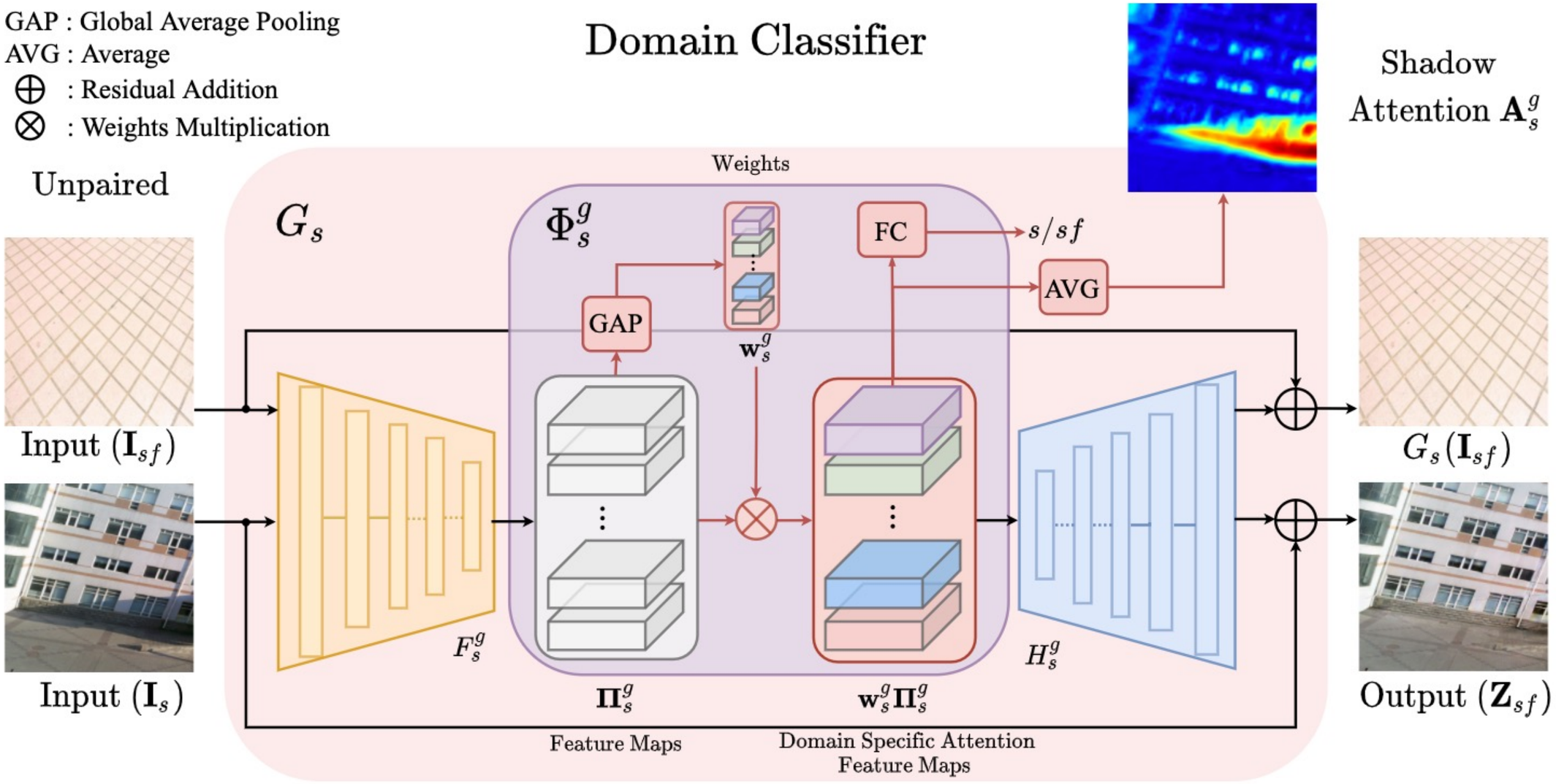
Shadow-Free Chromaticity Loss



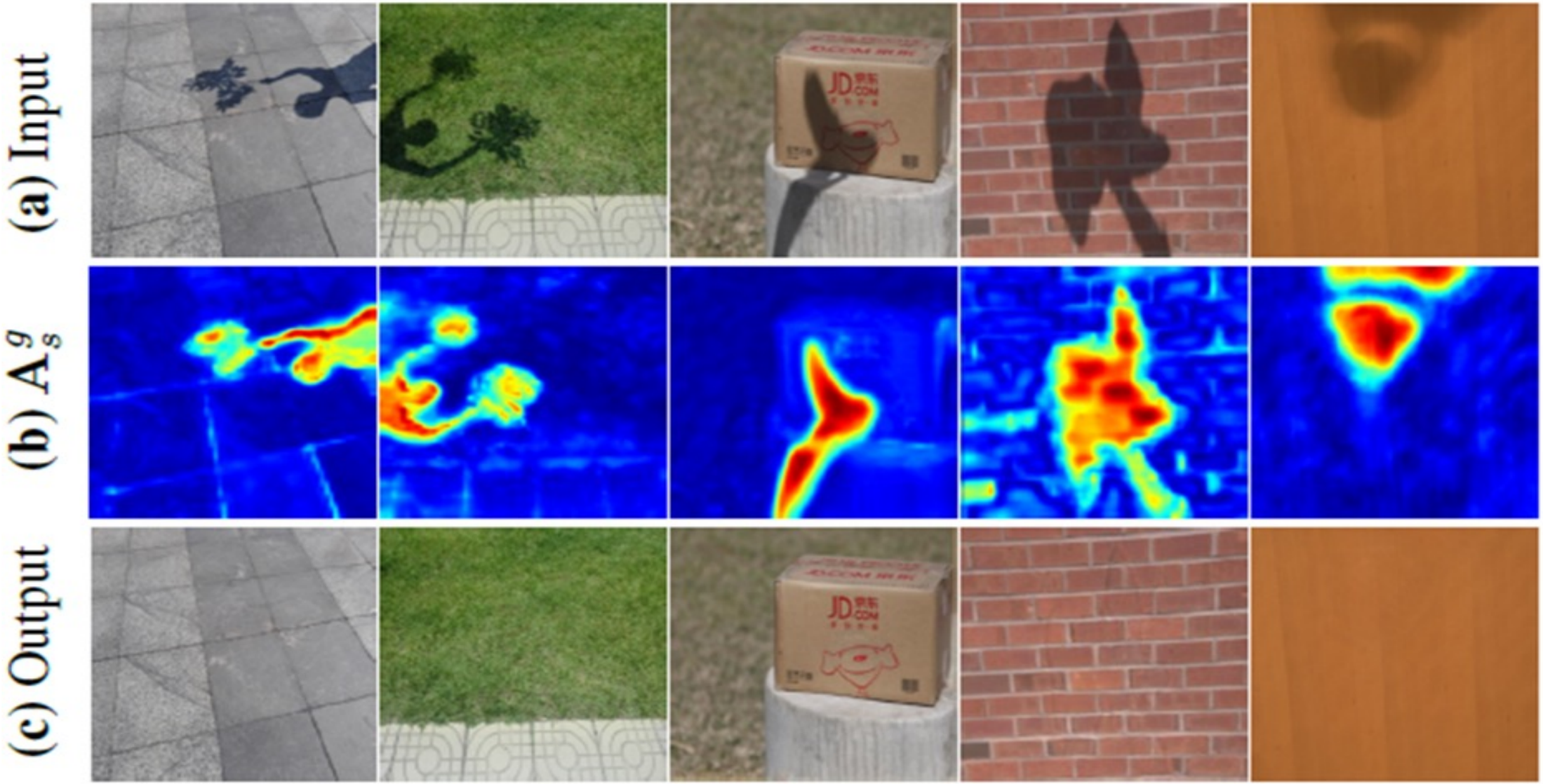
(a) Input Shadow $\mathbf{I}_s$ **(b)** Shadow-Free Chromaticity $\boldsymbol{\sigma}_{sf}^{\text{phy}}$ **(c)** Output Shadow-Free $\mathbf{Z}_{sf}$ **(d)** Chromaticity of the Output $\boldsymbol{\sigma}_{sf}^{\text{Z}}$

$$\mathcal{L}_{\text{chroma}}(G_s) = ||\boldsymbol{\sigma}_{sf}^{\mathbf{Z}} - \boldsymbol{\sigma}_{sf}^{\text{phy}}||_1$$

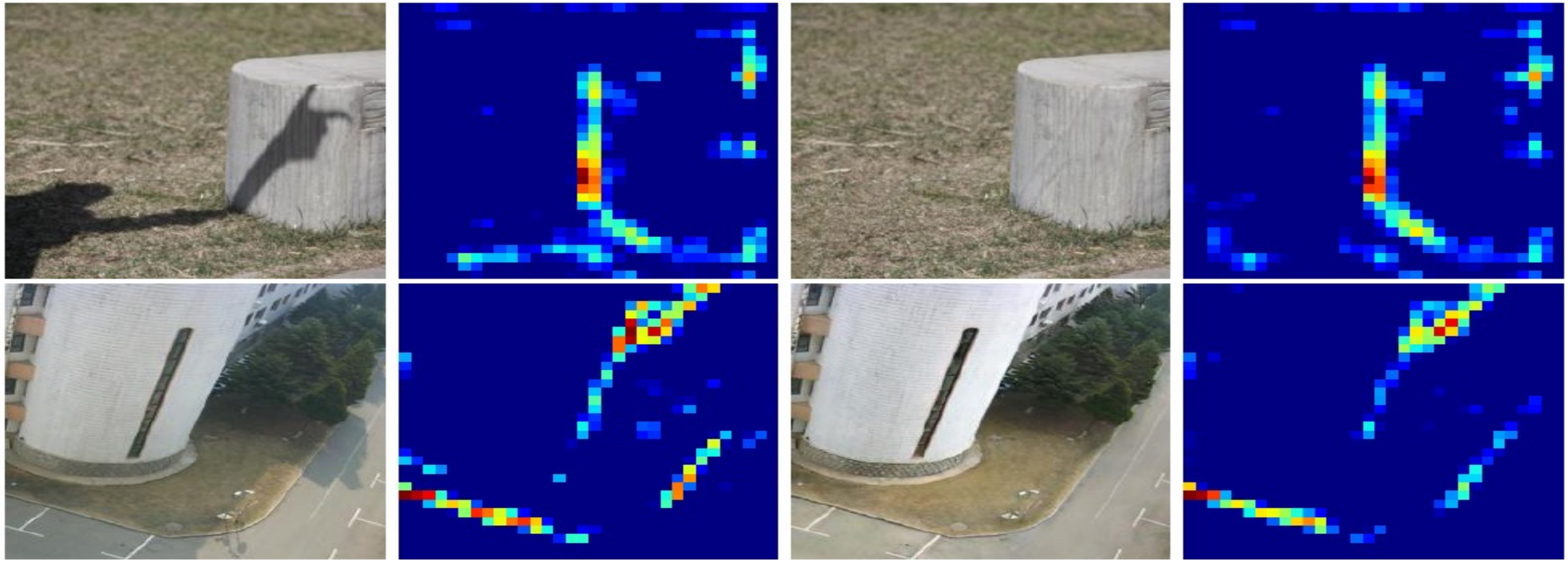
Domain Classifier



Domain Classifier



Shadow-Robust Feature Loss

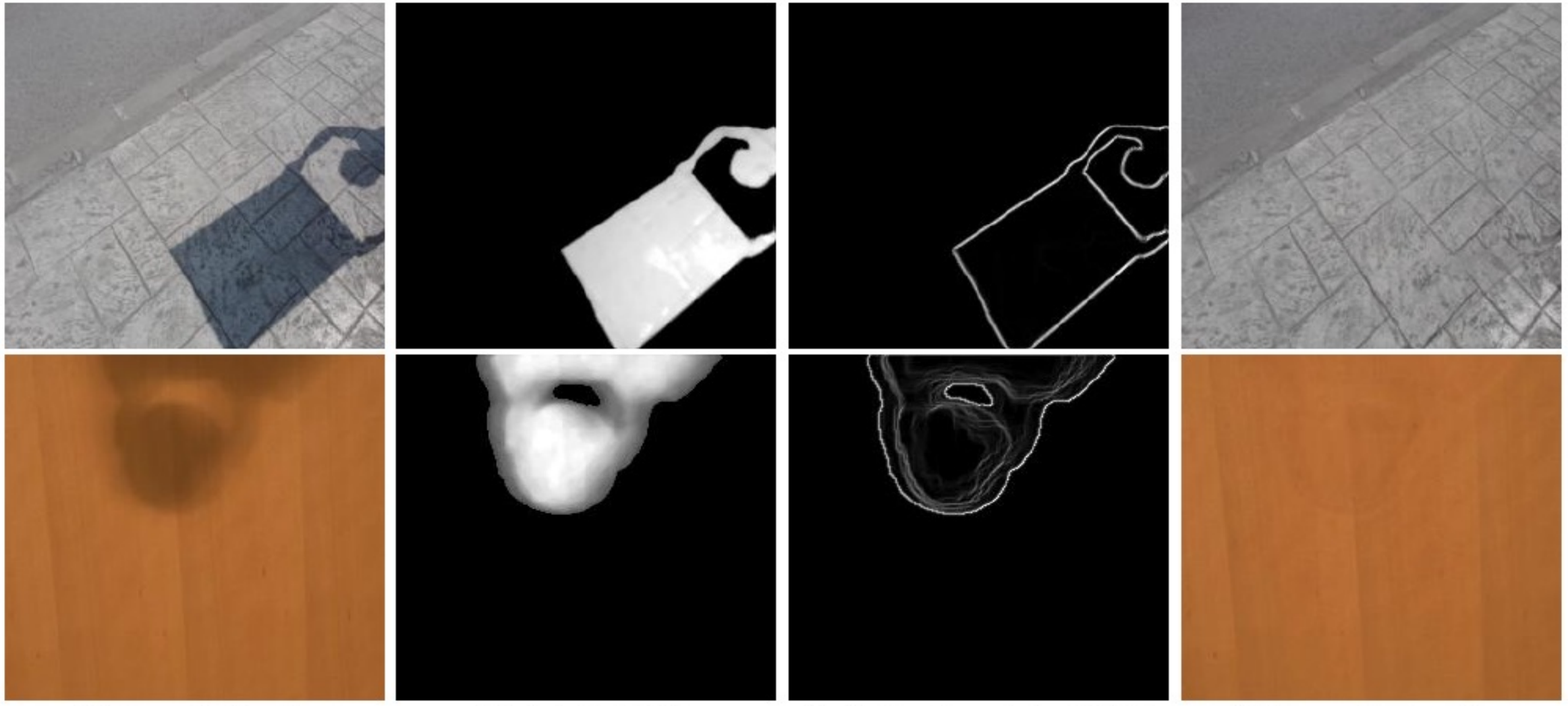


(a) Input Shadow $\mathbf{I}_s$ **(b)** Feature Map of the Input $V(\mathbf{I}_s)$ **(c)** Output Shadow-Free $\mathbf{Z}_{sf}$ **(d)** Feature Map of the Output $V(\mathbf{Z}_{sf})$

$$\mathcal{L}_{\text{feature}}(G_s) = \left\| V(\mathbf{Z}_{sf}) - V(\mathbf{I}_s) \right\|_1,$$

where $V(\mathbf{I}_s)$ and $V(\mathbf{Z}_{sf})$ denote the feature maps extracted from the Conv layer of the pre-trained VGG-16 network.

Boundary Smoothness Loss

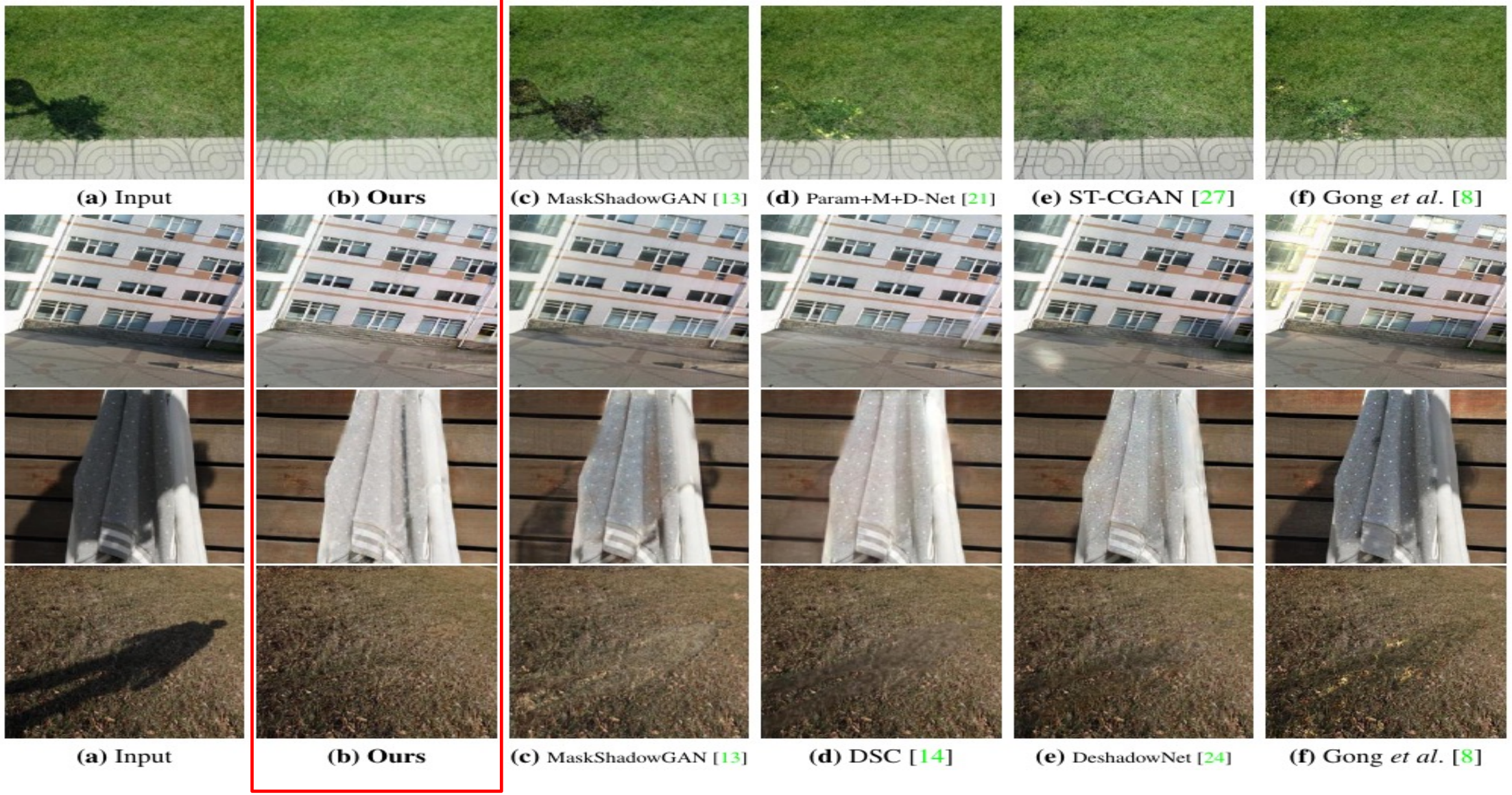


(a) Input Shadow $\mathbf{I}_s$ **(b)** Soft Mask $\mathbf{M}_s$ **(c)** Shadow Boundaries $\mathrm{B}(\mathbf{M}_s)$ **(d)** Output Shadow-Free

Results: Hard Shadows

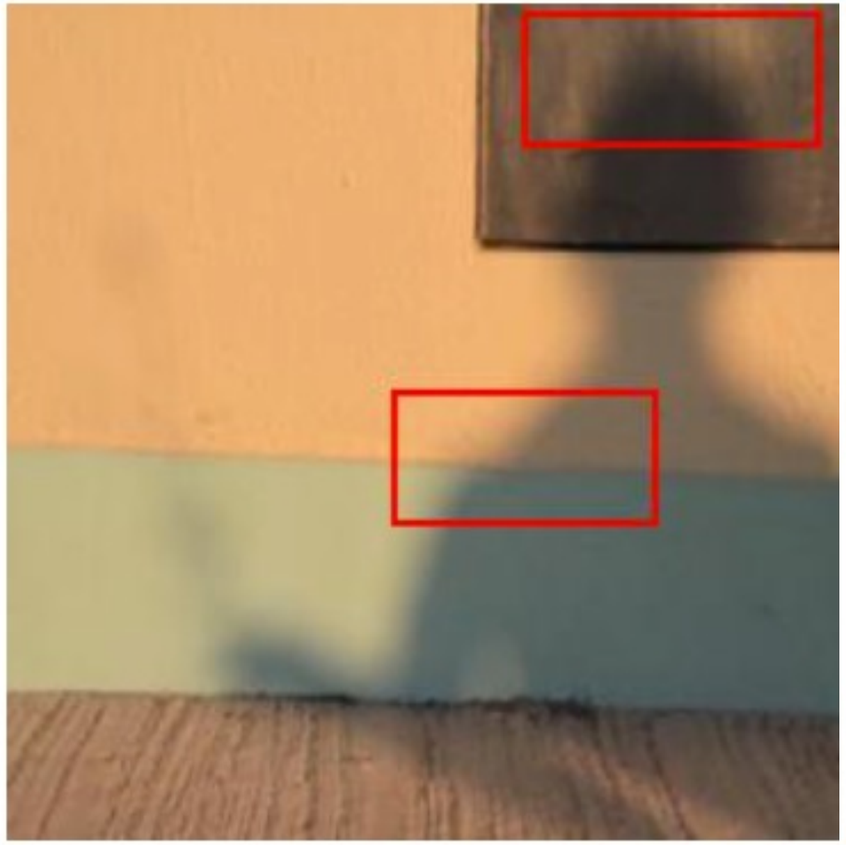
Results: Hard Shadows

Results: Hard Shadows

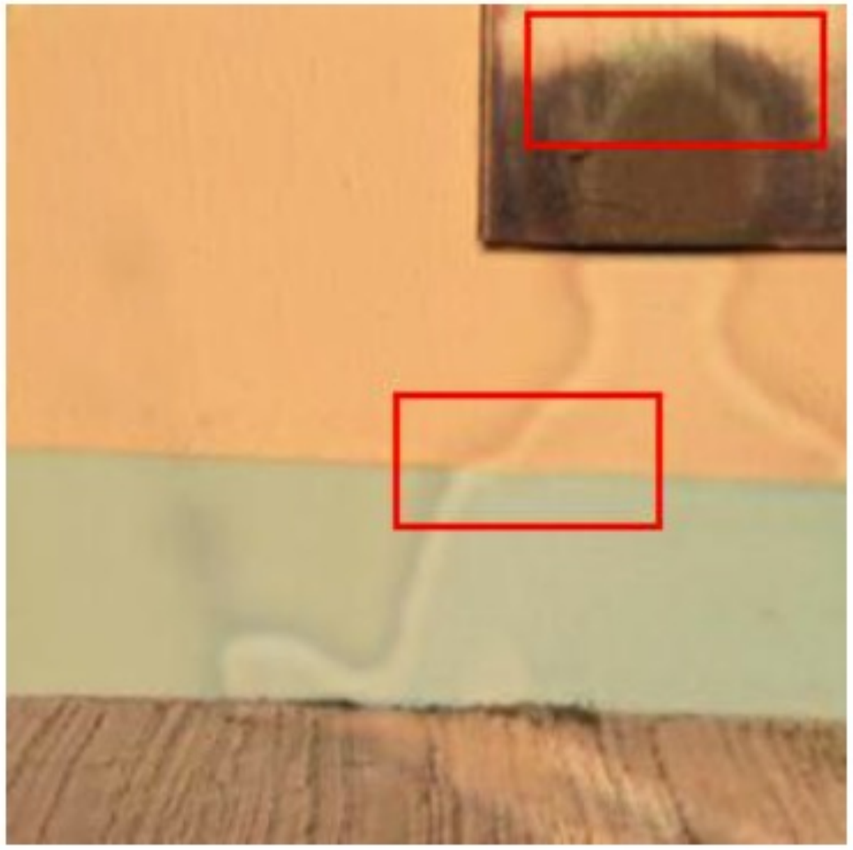


Results: Soft Shadows

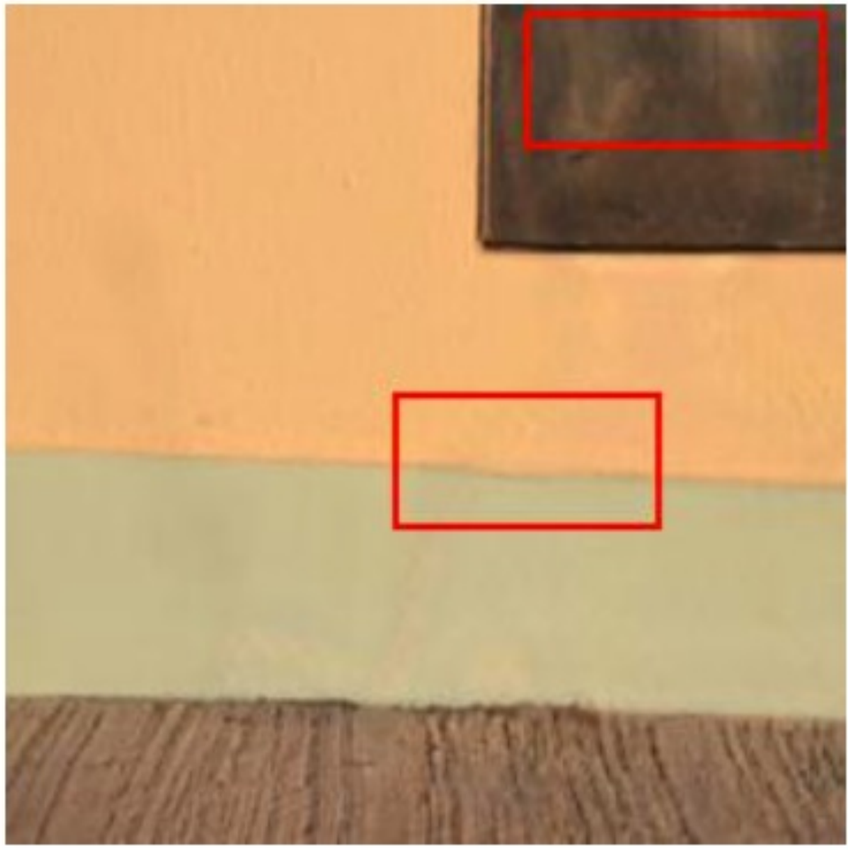
Results: Soft Shadows



(a) Input Image

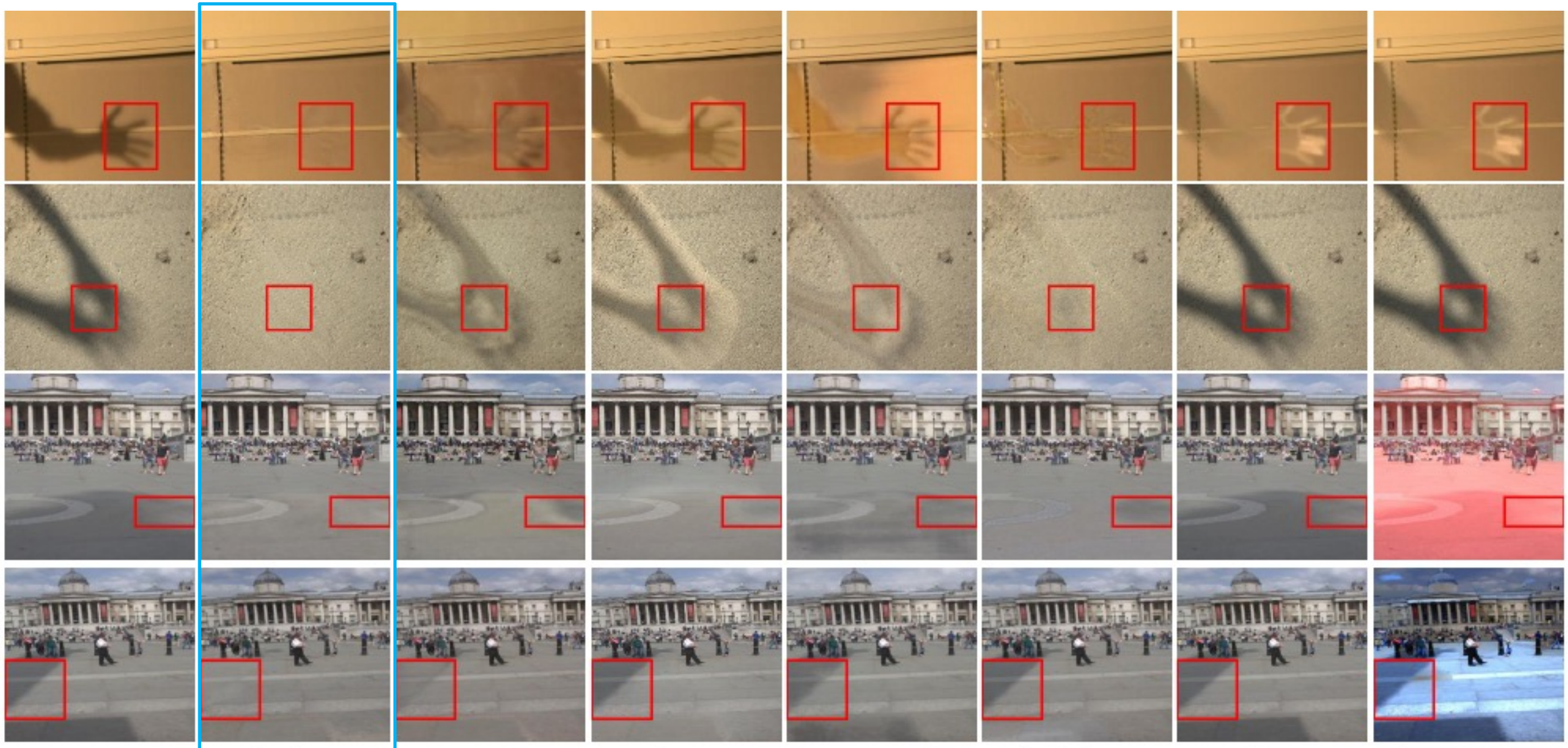


(c) Mask-ShadowGAN [13]



(d) Our DC-ShadowNet

Results: Soft Shadows



(a) Input (b) **Ours** (c) [13] (d) [20] (e) [1] (f) Gryka [9] (g) Guo [11] (h) [11] (auto)

Our Team Members

- Robby Tan (NUS)
- Jin Yeying (NUS)
- Yan Wending (NUS)
- Dengxing Dai (ETH/MPI)
- Yang Wenhan (NTU)
- Aashish Sharma (now A*STAR)

Thank You!

https://tanrobby.github.io/