Deep Snapshot HDR Imaging Using Multi-Exposure Color Filter Array

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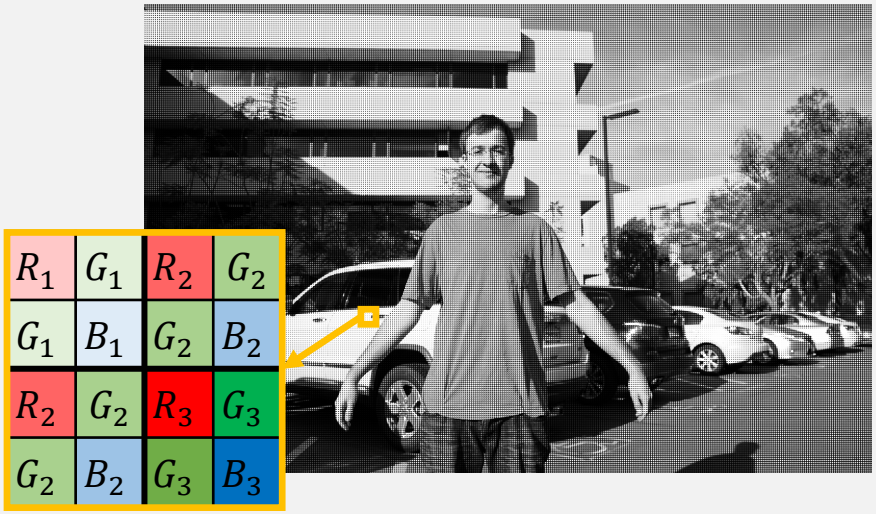
Tokyo Institute of Technology

Supplementary Materials

ACCV2020

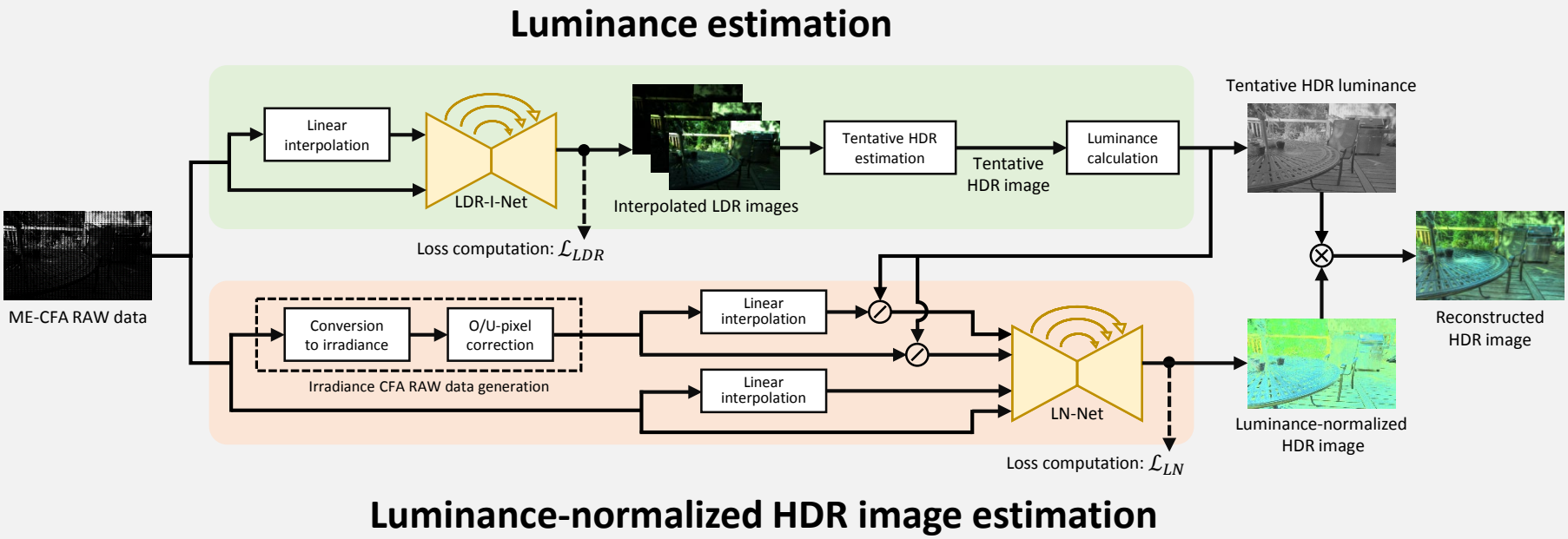
Our snapshot approach for HDR imaging



Multi-exposure CFA RAW data
(ME-CFA RAW data)

Reconstructed HDR image

Overview of our framework



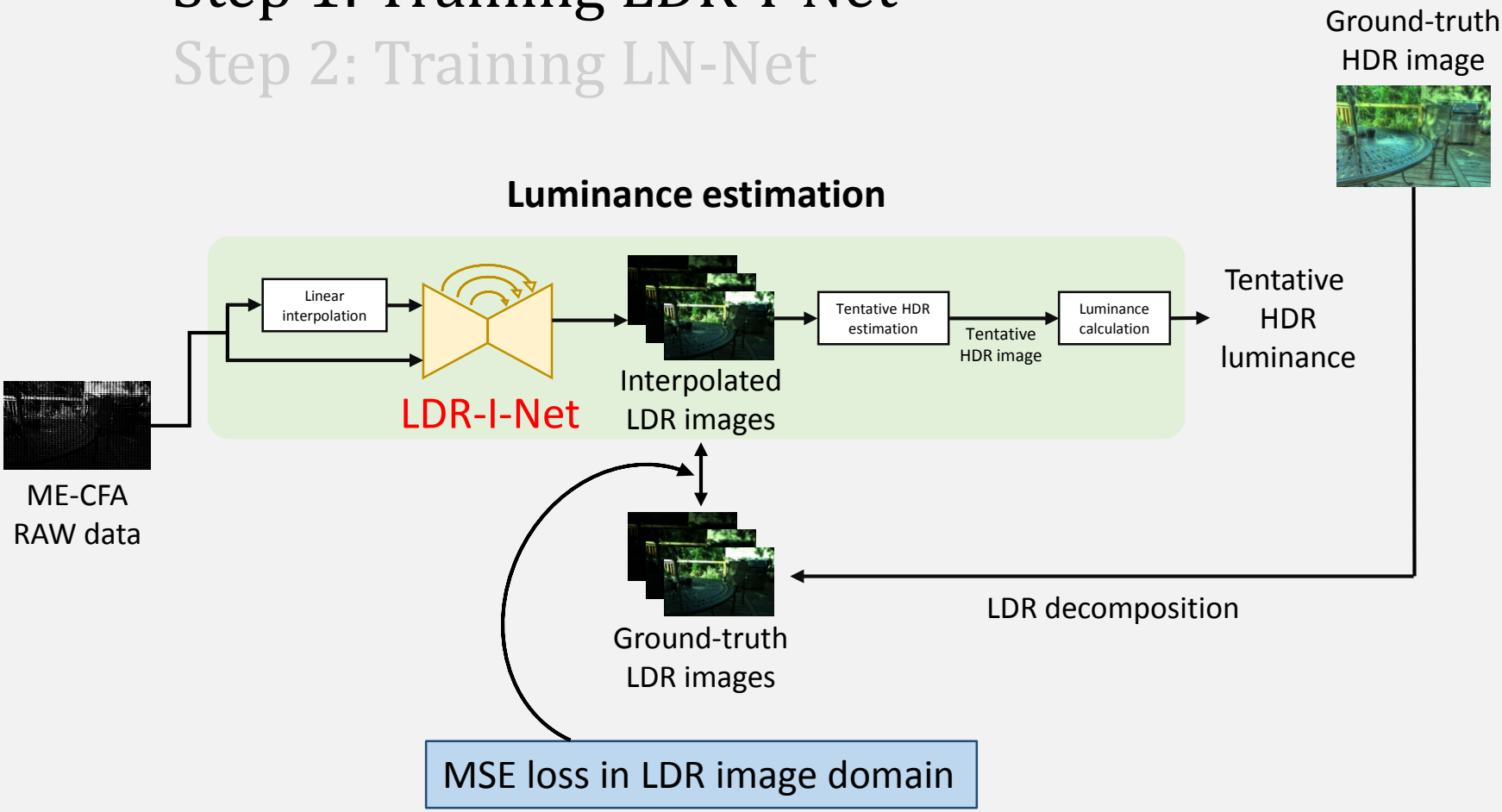
Our framework mainly consists of two parts:

1. Luminance estimation
2. Luminance-normalized HDR image estimation

Training phase:

Step 1: Training LDR-I-Net

Step 2: Training LN-Net

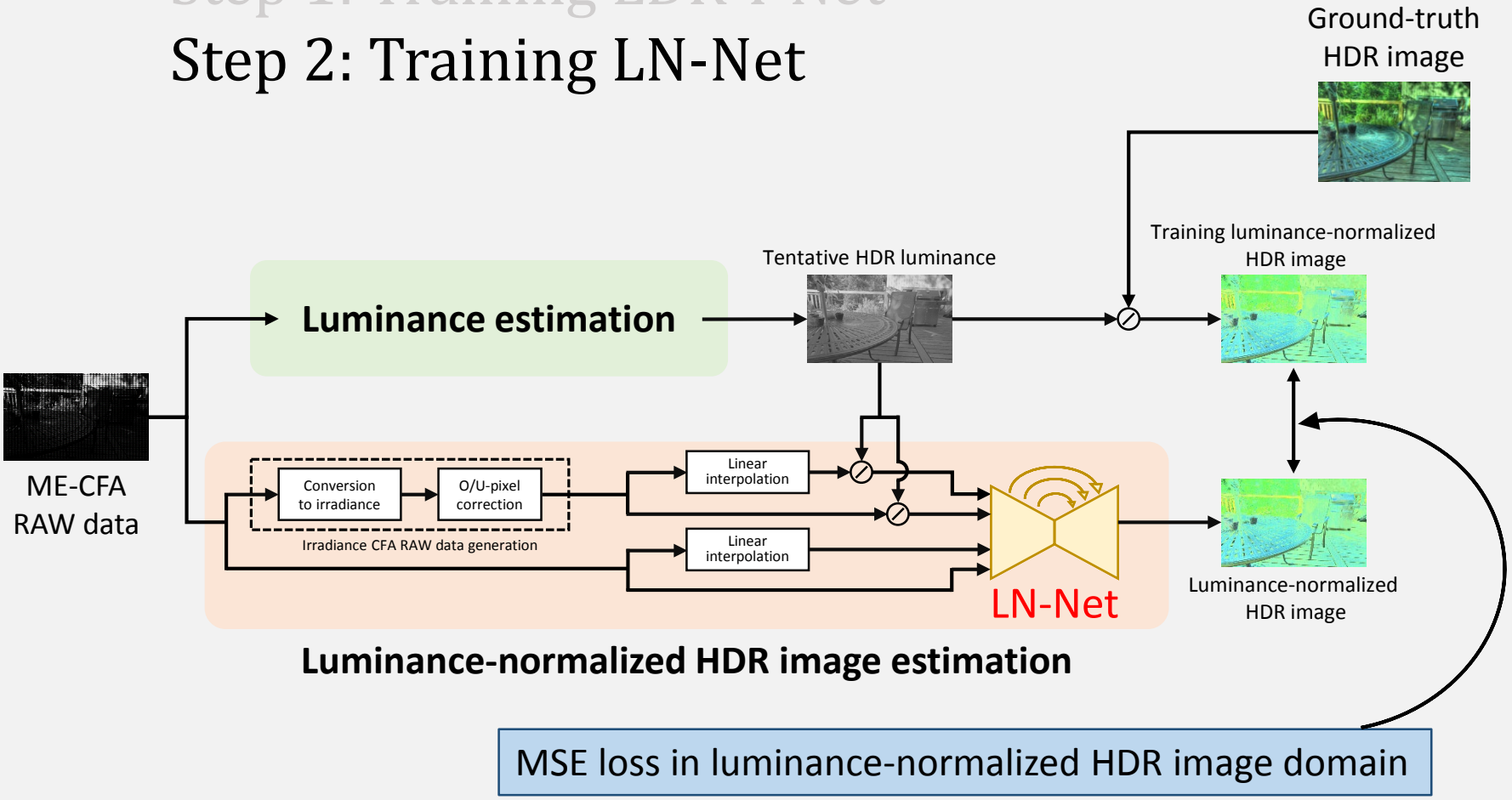


Training LDR interpolation network (LDR-I-Net) for estimating luminance

Training phase:

Step 1: Training LDR-I-Net

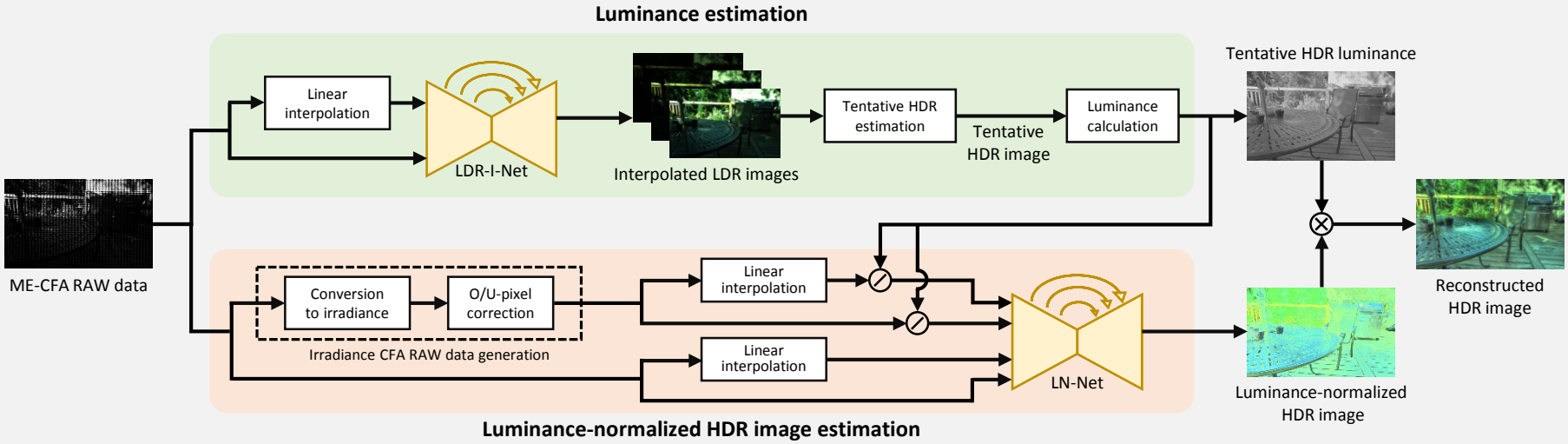
Step 2: Training LN-Net



Training luminance-normalized network (LN-Net) for HDR image estimation

Inference phase:

HDR image is reconstructed through the networks

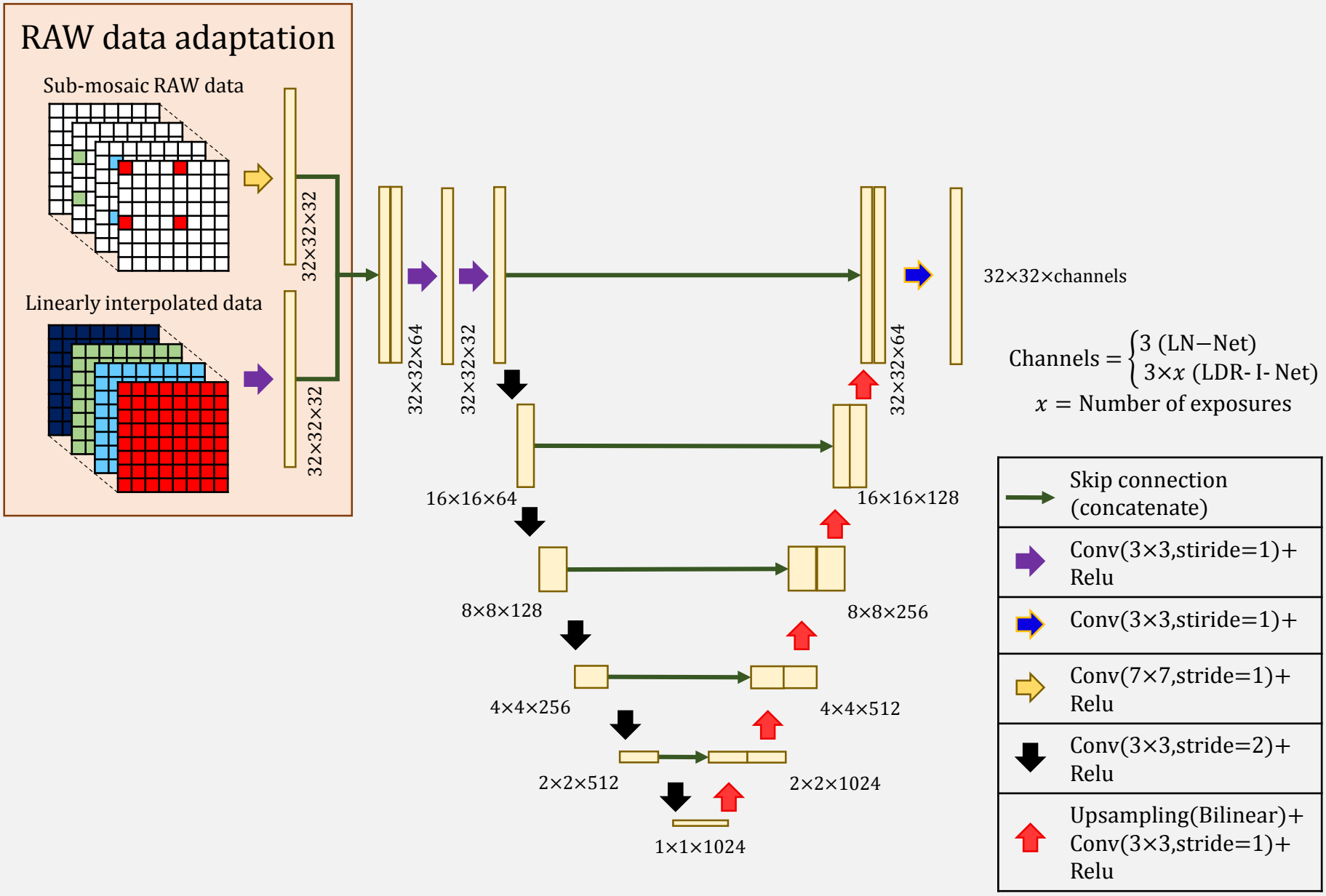


Tentative HDR luminance

Luminance-normalized HDR image

Reconstructed HDR image

Network architecture of LN-Net and LDR-I-Net



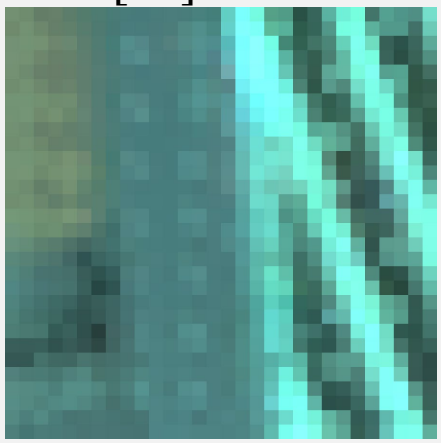
Comparison with Other Snapshot Methods Using Funt's Dataset

Scene 1
Detailed Comparison

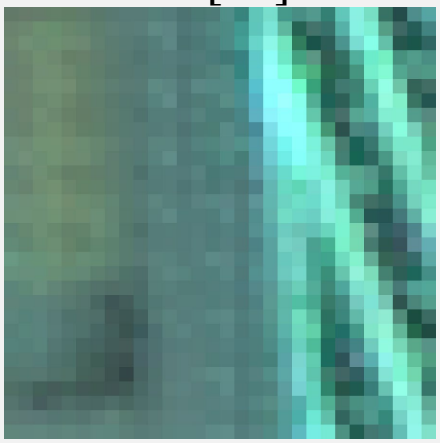
Visual Comparison

Ground-truth HDR image

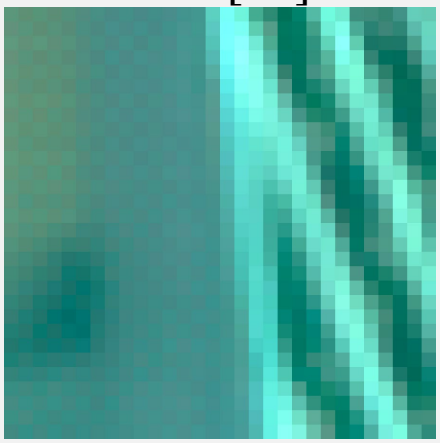
ARI [55]



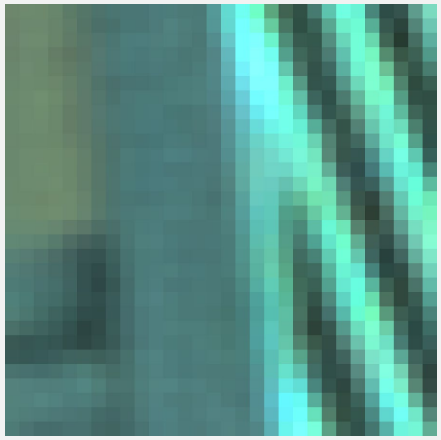
CDMNet [47]



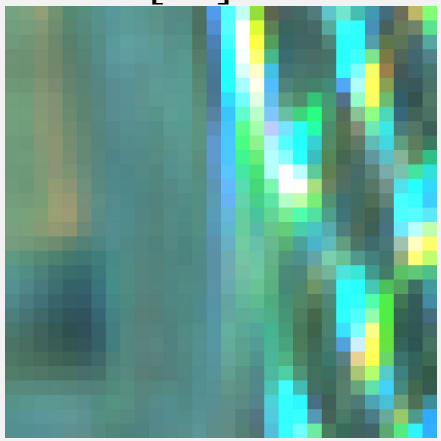
Kokkinos [48]



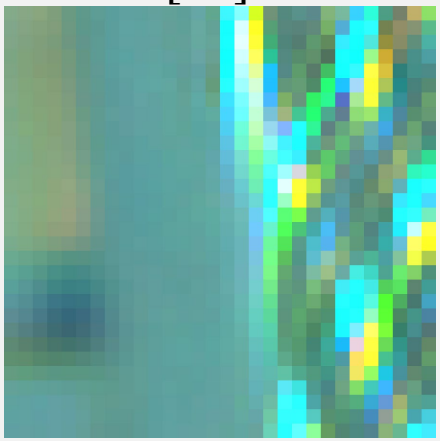
Ours



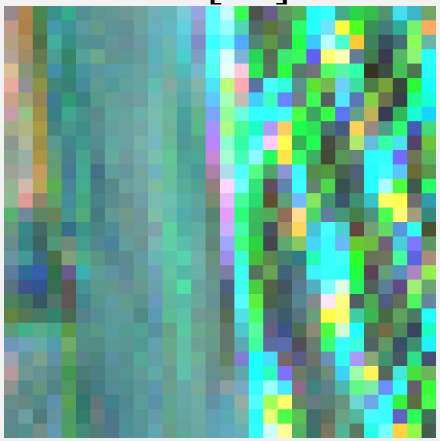
EDSR [58]



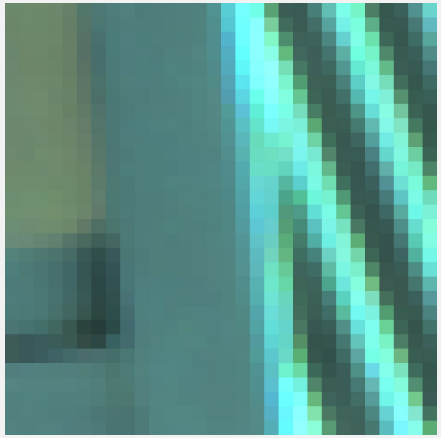
WDSR [57]



ESRGAN [56]



Ground Truth



Visual Comparison

Ground-truth HDR image

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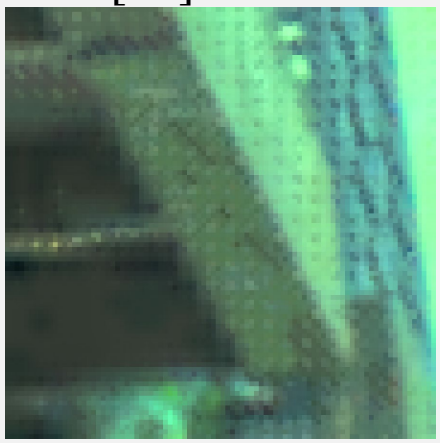
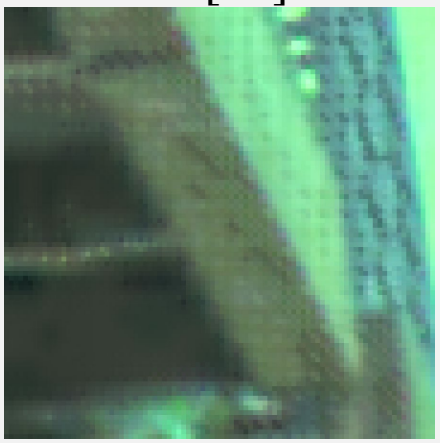


CDMNet [47]



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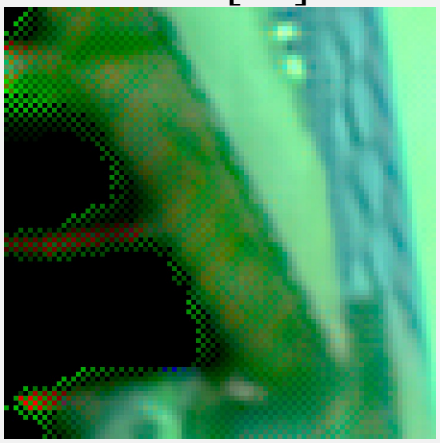

Ours

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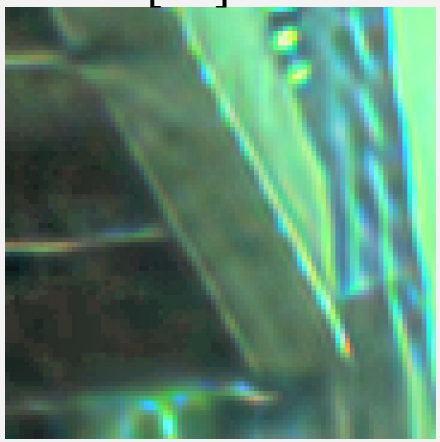

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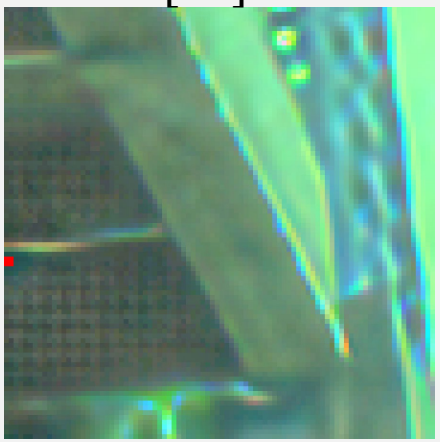

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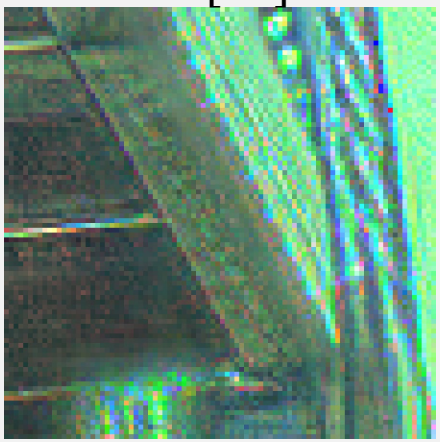

Ground Truth

Visual Comparison

Ground-truth HDR image

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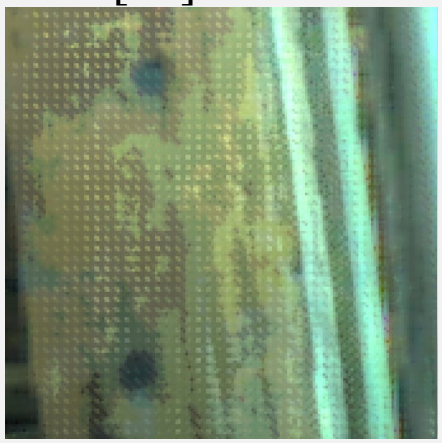

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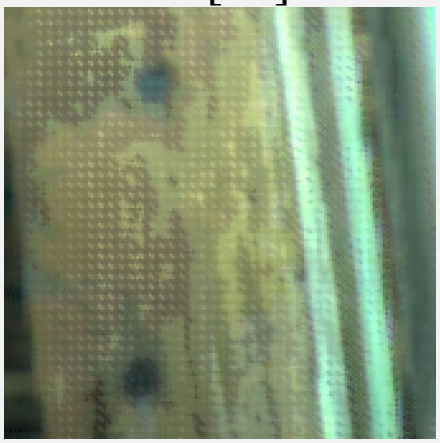

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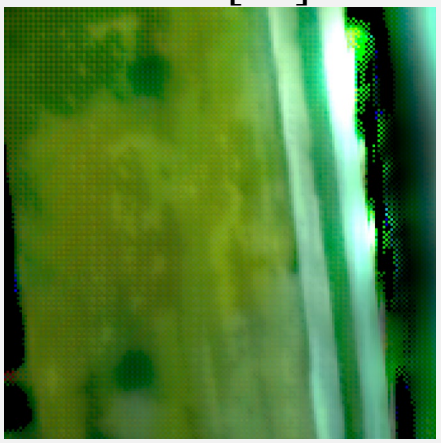
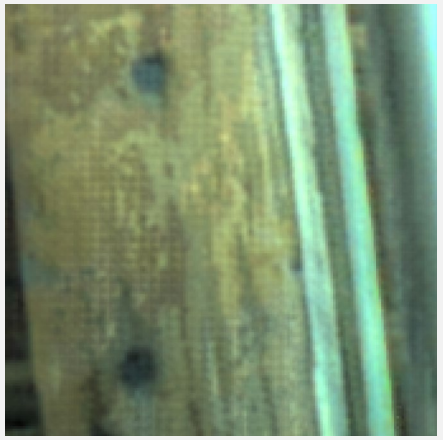
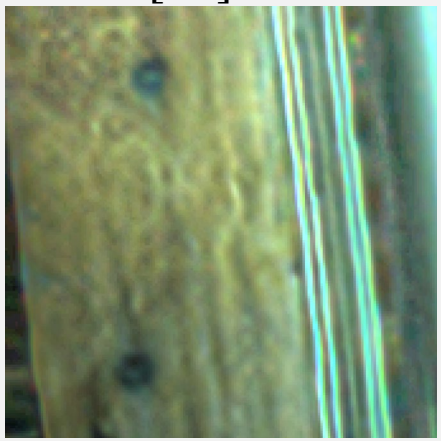


Ours



EDSR [58]



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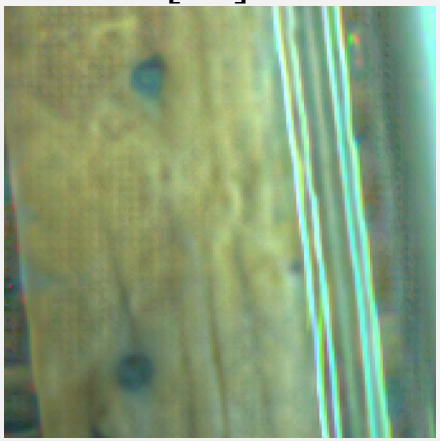

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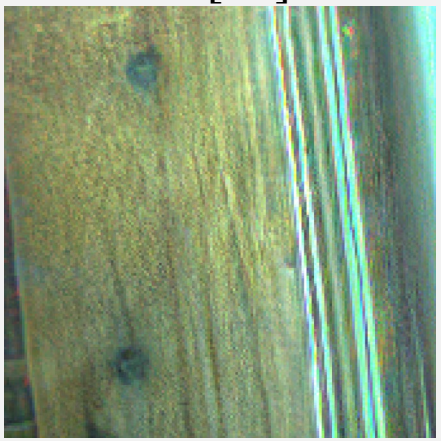


Ground Truth

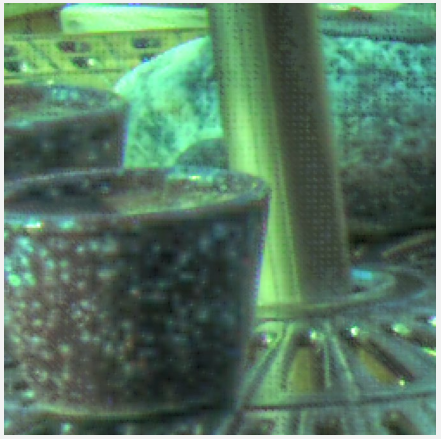
Scene 2
Detailed Comparison

Visual Comparison

Ground-truth HDR image

ARI [55]

CDMNet [47]



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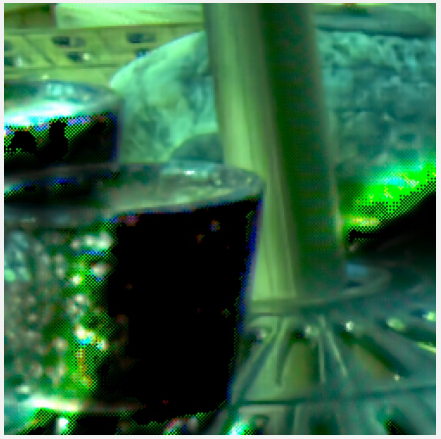

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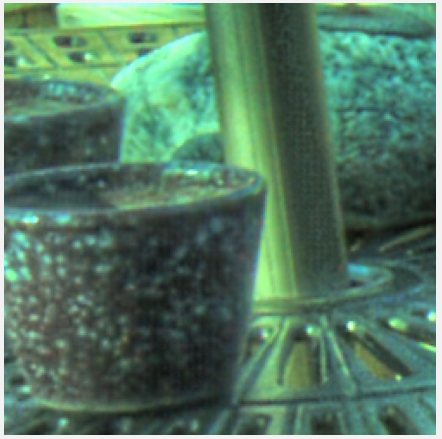

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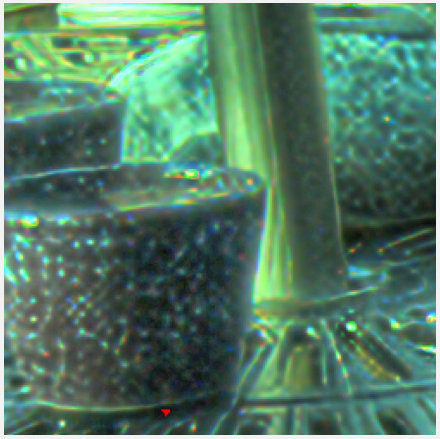

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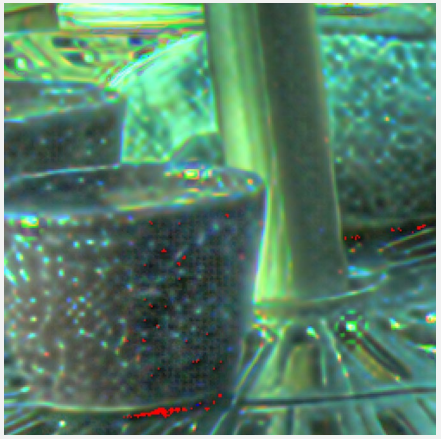

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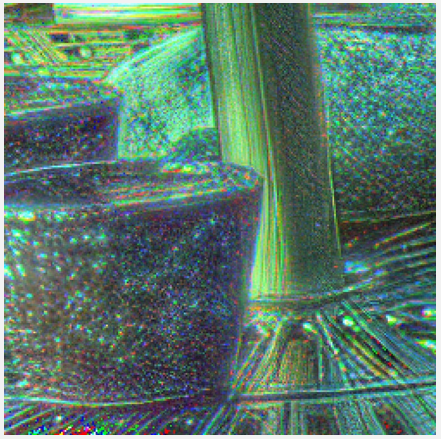
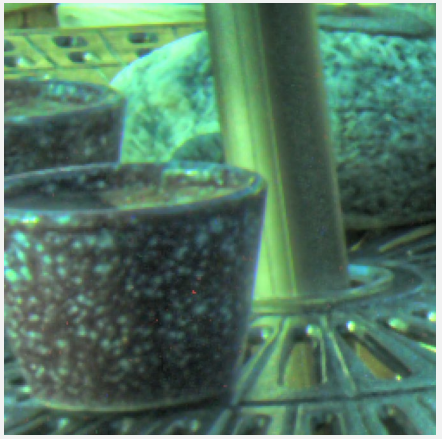
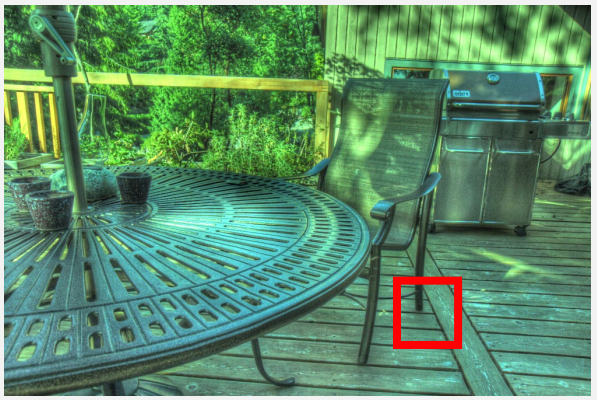


Ground Truth



Visual Comparison

Ground-truth HDR image



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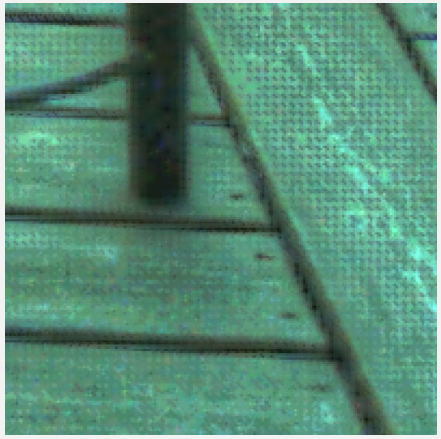
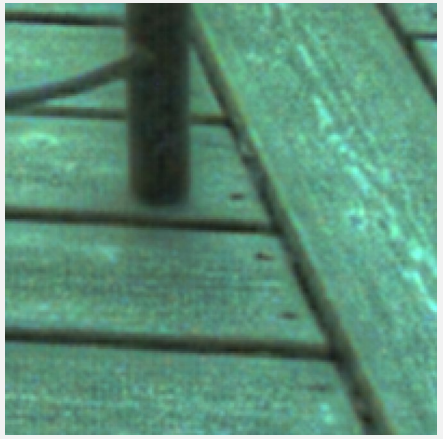


CDMNet [47]

Kokkinos [48]

Ours



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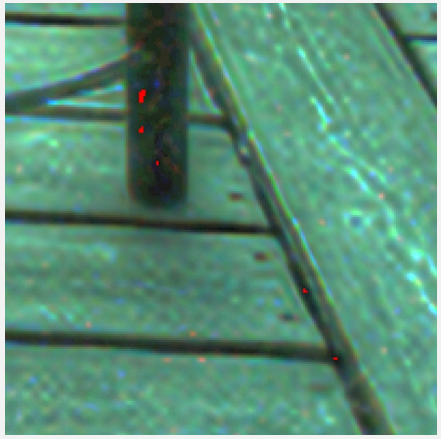

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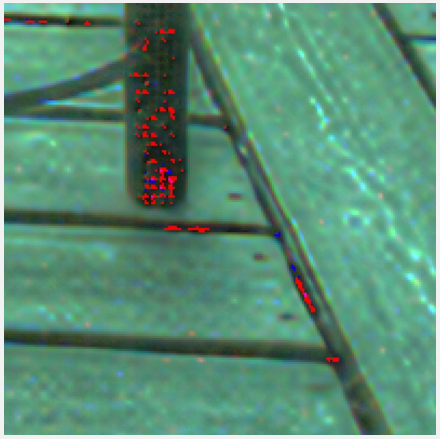

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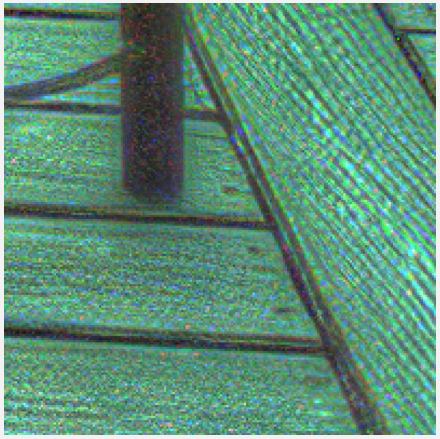

Ground Truth

Visual Comparison

Ground-truth HDR image

ARI [55]

CDMNet [47]

Kokkinos [48]

Ours

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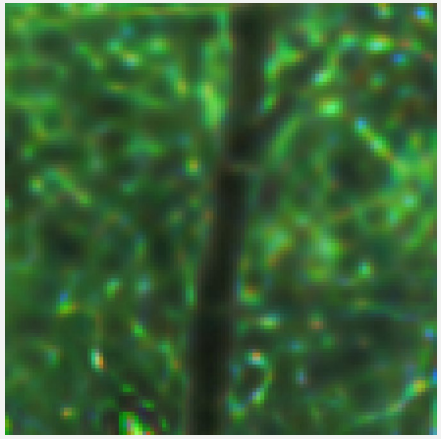

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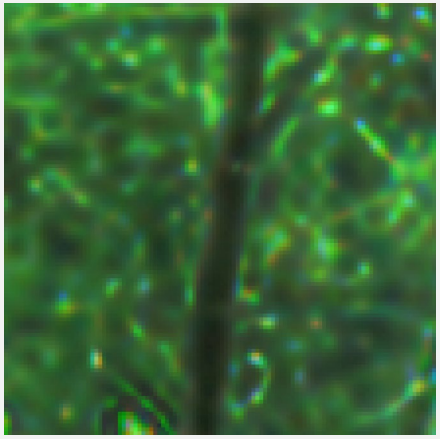

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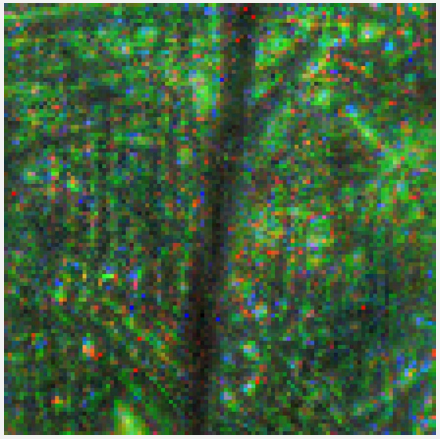
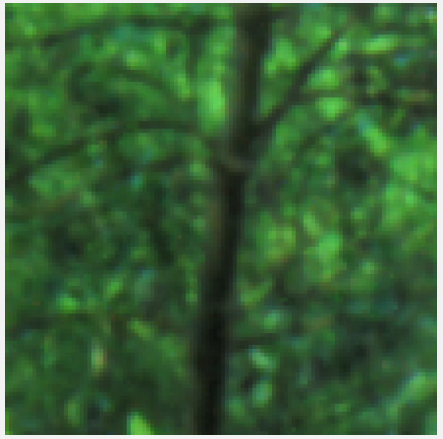


Ground Truth

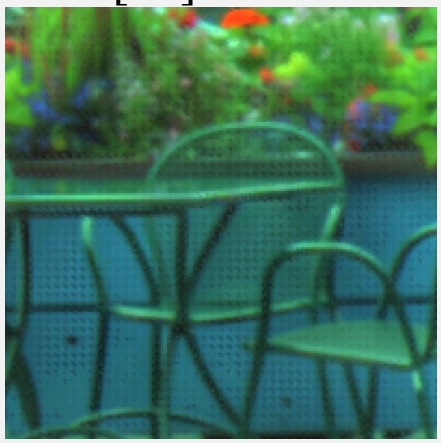


Scene 3
Detailed Comparison

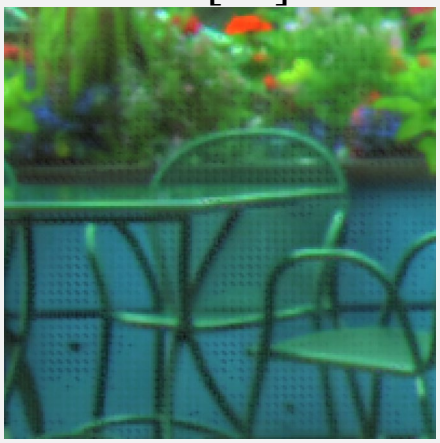
Visual Comparison

Ground-truth HDR image

ARI [55]



CDMNet [47]



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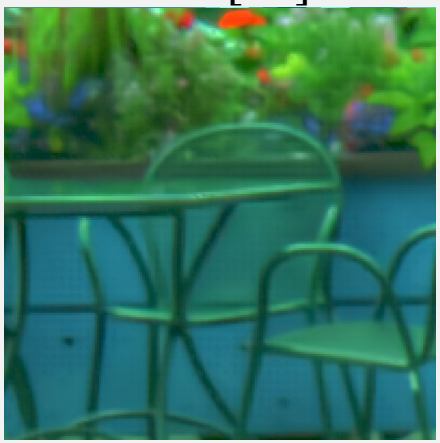
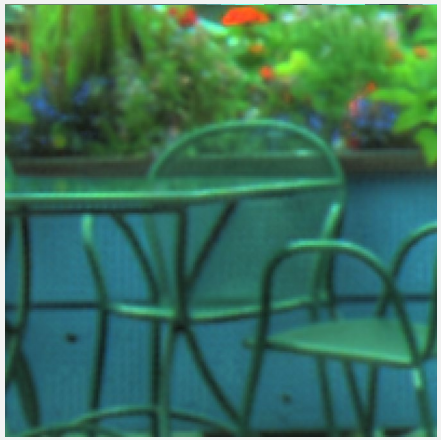


Ours



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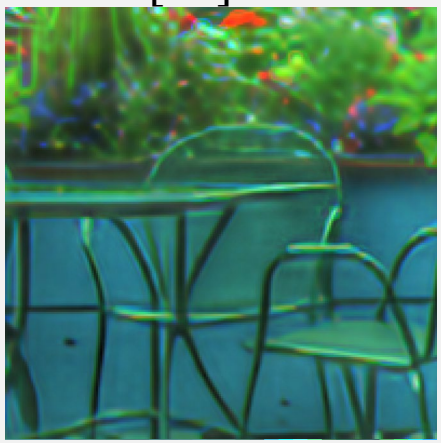

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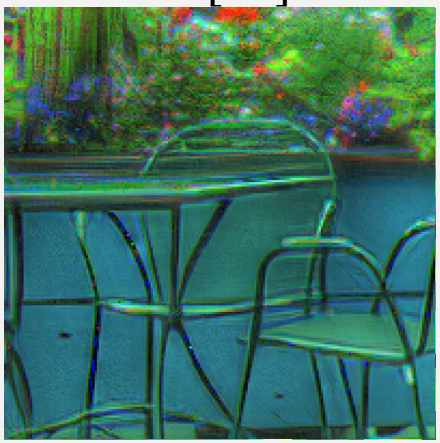
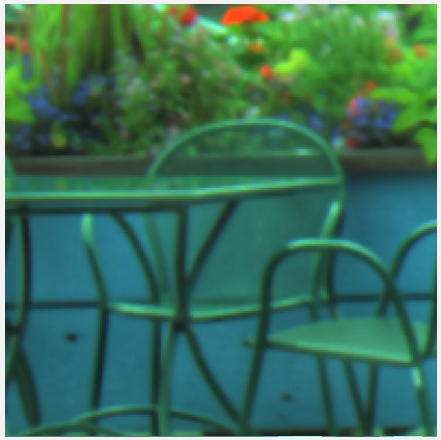


Ground Truth



Visual Comparison

Ground-truth HDR image

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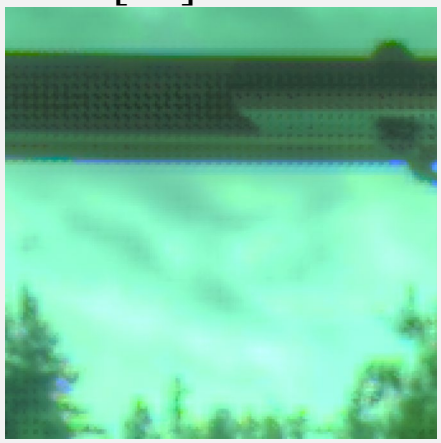
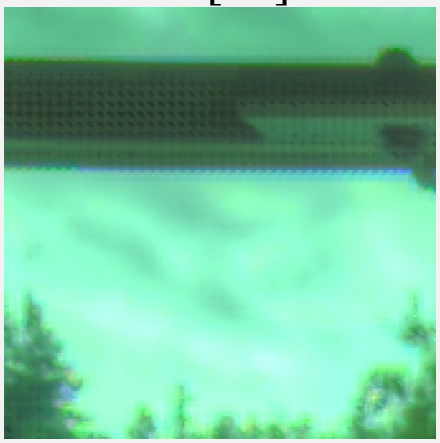


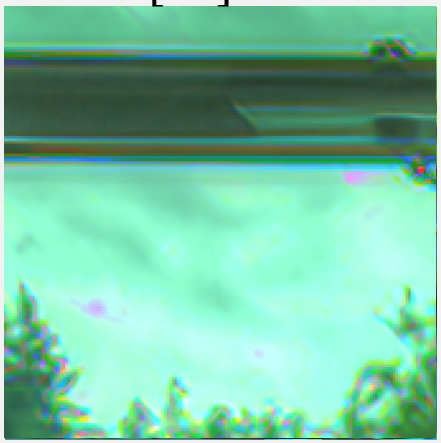
CDMNet [47]



Kokkinos [48]

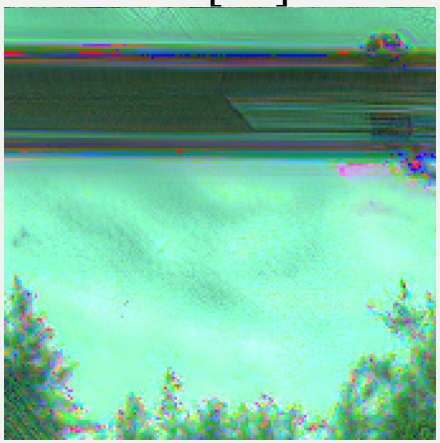
Ours

EDSR [58]

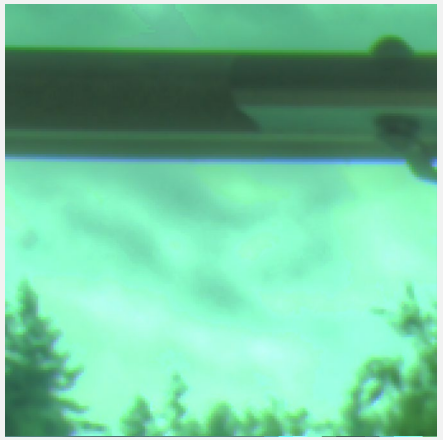


WDSR [57]

ESRGAN [56]



Ground Truth

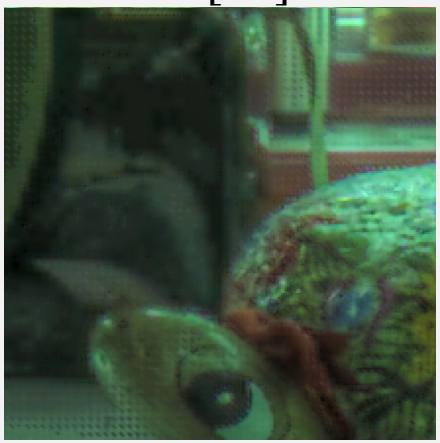


Visual Comparison

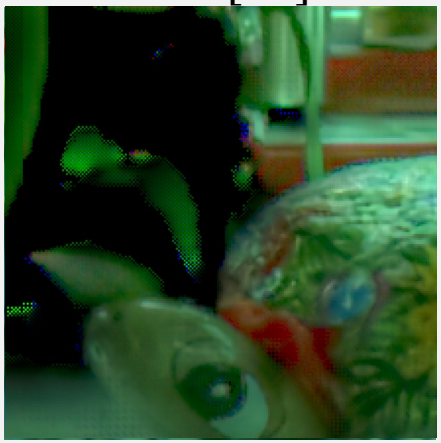
Ground-truth HDR image

ARI [55]

CDMNet [47]



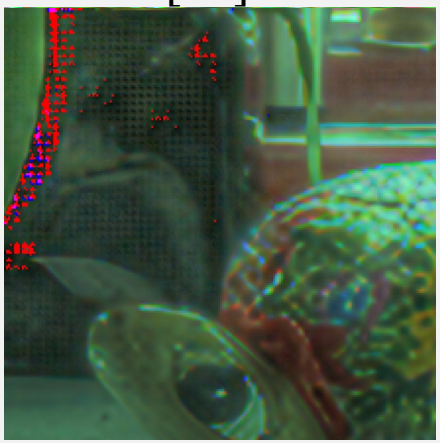
Kokkinos [48]



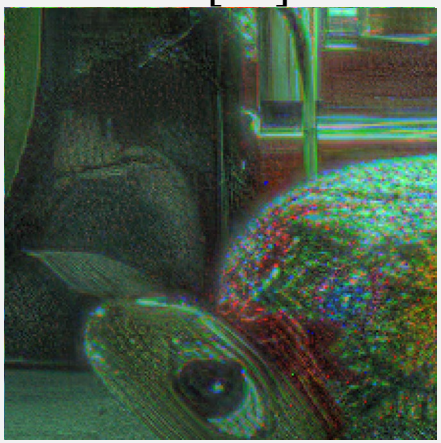
Ours

EDSR [58]

WDSR [57]



ESRGAN [56]



Ground Truth

Scene 1
Full-Size Image Comparison

ARI [55]: CPSNR: 48.58dB HDR-VDP-2: 74.00

Irradiance RAW data generation → Bayer demosaicking

CDMNet [47]: CPSNR: 38.18dB HDR-VDP-2: 56.62 Irradiance RAW data generation → Bayer demosaicking

Kokkinos [48]: CPSNR: 44.45dB HDR-VDP-2: 68.78 Irradiance RAW data generation → Bayer demosaicking

ESRGAN [56]: CPSNR: 32.57dB HDR-VDP-2: 52.29

LDR interpolation → HDR reconstruction

WDSR [57]: CPSNR: 28.39dB HDR-VDP-2: 49.58

LDR interpolation → HDR reconstruction

EDSR [58]: CPSNR: 37.87dB HDR-VDP-2: 54.13

LDR interpolation → HDR reconstruction

Ours: CPSNR: 50.79dB HDR-VDP-2: 77.95

Our method

Ground Truth

Scene 2
Full-Size Image Comparison

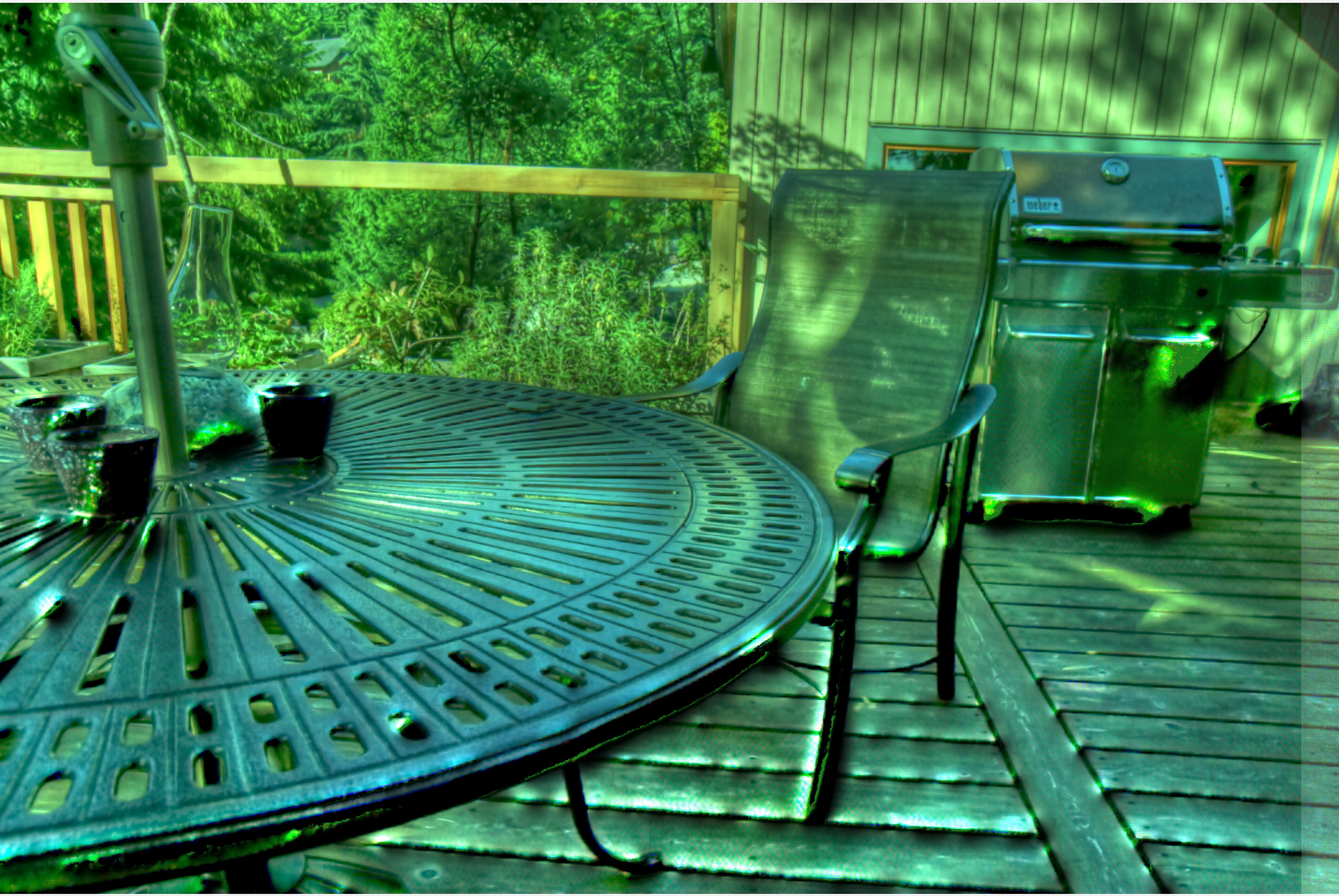
ARI [55]: CPSNR: 50.86dB HDR-VDP-2: 75.16

Irradiance RAW data generation → Bayer demosaicking

CDMNet [47]: CPSNR: 37.27dB HDR-VDP-2: 22.32

Irradiance RAW data generation → Bayer demosaicking

Kokkinos [48]: CPSNR: 44.17dB HDR-VDP-2: 68.00 Irradiance RAW data generation → Bayer demosaicking



ESRGAN [56]: CPSNR: 28.27dB HDR-VDP-2: 49.32

LDR interpolation → HDR reconstruction

WDSR [57]: CPSNR: 31.07dB HDR-VDP-2: 48.90

LDR interpolation → HDR reconstruction

EDSR [58]: CPSNR: 41.94dB HDR-VDP-2: 67.85

LDR interpolation → HDR reconstruction

Ours: CPSNR: 54.35dB HDR-VDP-2: 84.28

Our method

Ground Truth

Scene 3
Full-Size Image Comparison

ARI [55]: CPSNR: 50.28dB HDR-VDP-2: 73.62

Irradiance RAW data generation → Bayer demosaicking

CDMNet [47]: CPSNR: 37.27dB HDR-VDP-2: 21.28 Irradiance RAW data generation → Bayer demosaicking

Kokkinos [48]: CPSNR: 44.86dB HDR-VDP-2: 66.65 Irradiance RAW data generation → Bayer demosaicking

ESRGAN [56]: CPSNR: 32.71dB HDR-VDP-2: 48.51

LDR interpolation → HDR reconstruction

WDSR [57]: CPSNR: 33.67dB HDR-VDP-2: 50.04

LDR interpolation → HDR reconstruction

EDSR [58]: CPSNR: 41.62dB HDR-VDP-2: 63.80

LDR interpolation → HDR reconstruction

Ours: CPSNR: 53.17dB HDR-VDP2: 79.65

Our method

Ground Truth

Comparison with State-of-the-art Methods Using Kalantari's Dataset

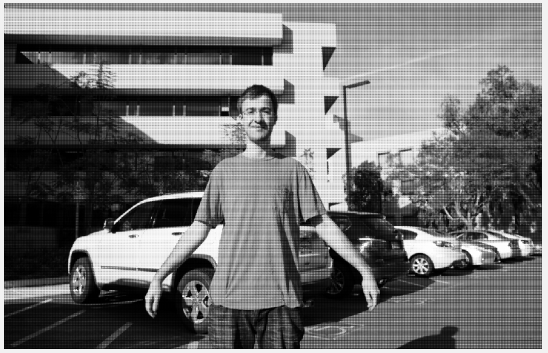
Scene 1
Full-Size Image Comparison

Inputs for each method

LDR images for
multi-LDR-images-based method

→ Single-LDR-image-based
method input

Multi-exposure CFA RAW
for our method



Sen [17]: CPSNR: 18.99dB HDR-VDP-2: 34.16

Multi-LDR-images-based method

Kalantari [2]: CPSNR: 19.28dB HDR-VDP-2: 55.99

Multi-LDR-images-based method

Wu [3]: CPSNR: 21.85dB HDR-VDP-2: 58.85

Multi-LDR-images-based method

HDRCNN [6]: CPSNR: 3.90dB HDR-VDP-2: 52.19

Single-LDR-image-based method

DrTMO [31]: CPSNR: 20.22dB HDR-VDP-2: 38.98

Single-LDR-image-based method

ExpandNet [5]: CPSNR: 17.04dB HDR-VDP-2: 57.67

Single-LDR-image-based method

Ours: CPSNR: 37.05dB HDR-VDP-2: 65.08

Our snapshot method

Ground Truth

Error Map

Ground-truth HDR image

Ours

Sen [17]

Kalantari [2]

Wu [3]

HDRCNN [6]

DrTMO [31]

ExpandNet [5]

Scene 2
Full-Size Image Comparison

Inputs for each method

LDR images for
multi-LDR-images-based method

→ Single-LDR-image-based
method input

Multi-exposure CFA RAW
for our method

Sen [17]: CPSNR: 22.42dB HDR-VDP-2: 33.12

Multi-LDR-images-based method

Kalantari [2]: CPSNR: 27.19dB HDR-VDP-2: 56.81

Multi-LDR-images-based method

Wu [3]: CPSNR: 29.46dB HDR-VDP-2: 59.38

Multi-LDR-images-based method

HDRCNN [6]: CPSNR: 4.48dB HDR-VDP-2: 55.45

Single-LDR-image-based method

DrTMO [31]: CPSNR: 16.93dB HDR-VDP-2: 34.40

Single-LDR-image-based method

ExpandNet [5]: CPSNR: 15.17dB HDR-VDP-2: 55.21

Single-LDR-image-based method

Ours: CPSNR: 32.95dB HDR-VDP-2: 63.62

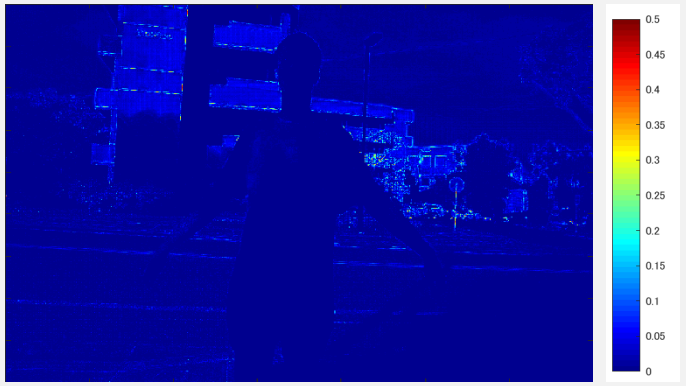
Our snapshot method

Ground Truth

Error Map

Ground-truth HDR image

Ours



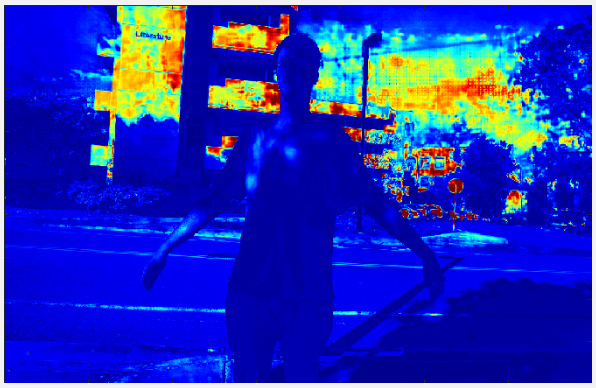
Sen [17]

Kalantari [2]

Wu [3]

HDRCNN [6]

DrTMO [31]



ExpandNet [5]