CANet: A Context-Aware Network for Shadow Removal

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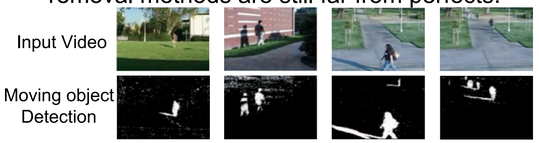
Paper QR code

1 Background & Problems

- Low lightness in the shadow region usually inevitably degrade the performance of some computer vision tasks. So shadow removal is an important and necessary task.
- Due to ignoring the contextual matching information hidden in images, existing shadow removal methods are still far from perfects.



2 Motivation

- Shadow removal is important for other computer vision tasks.
- There are some potential matching pairs in images, which can be used to guide shadow removal.
- We can learn a model to accurately find the matching pairs in the image according to existing datasets.

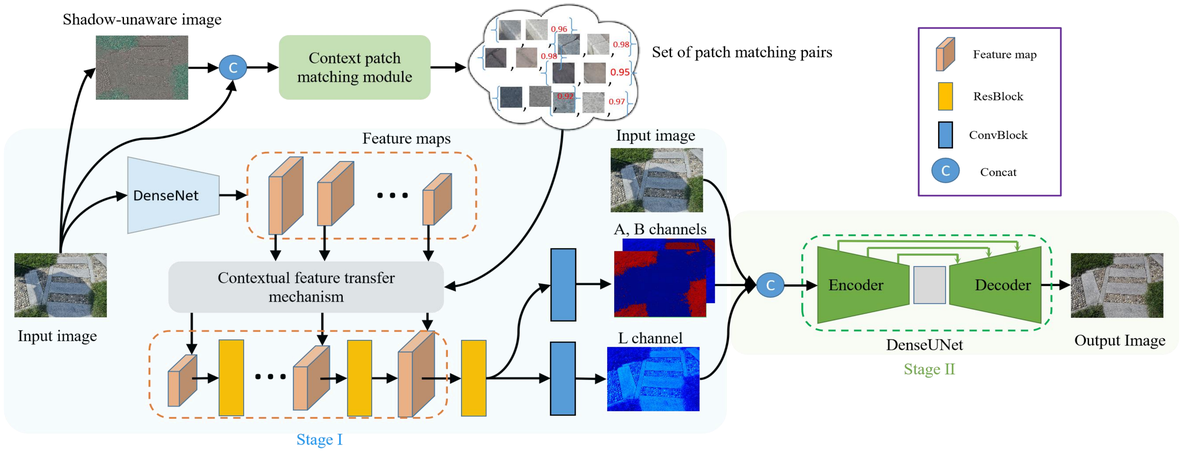
3 Contribution

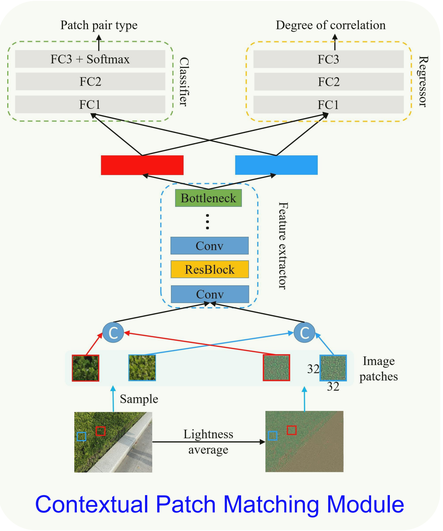
- A novel two-stage context-aware network CANet for shadow removal.
- A trainable contextual patch matching module to obtain potential contextual relationships.
- Superior performance over SOTA methods.

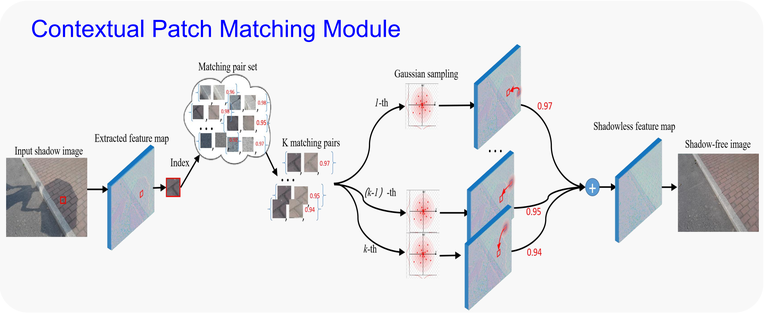
4 Datesets & Metrics

- Datasets: ISTD and SRD datasets.
- Metrics: RMSE between output and ground truth.

5 Overview







Loss Function

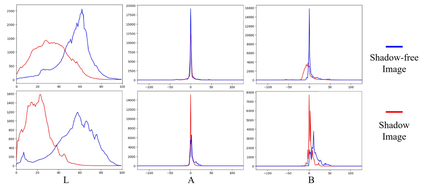
$$\mathcal{L}_{\text{CANet}} = \lambda_1 \mathcal{L}_{rem} + \lambda_2 \mathcal{L}_{per} + \lambda_3 \mathcal{L}_{grad}$$

$$\mathcal{L}_{rem} = \|I_{gt} - I_{out}\|_2$$

$$\mathcal{L}_{per} = \|VGG(I_{gt}) - VGG(I_{out})\|_1$$

$$\mathcal{L}_{grad} = \|\nabla I_{gt} - \nabla I_{out}\|_1$$

LAB Analyze



6 Experiment Results

Method	ISTD			SRD		
	S	N	A	S	N	A
Guo	18.95	7.46	9.3	29.89	6.47	12.60
Zhang	13.77	7.17	8.16	9.50	6.90	7.24
DeshadowNet	12.76	7.19	7.83	17.96	6.53	8.47
ST-CGAN	10.33	6.93	7.47	12.65	6.37	7.83
Mask-shadowGAN	10.35	7.03	7.61	10.32	6.83	7.32
ARGAN	9.21	6.27	6.63	8.13	6.05	6.23
DSC	9.22	6.39	6.67	8.22	6.01	6.21
RIS-GAN	9.15	6.31	6.62	8.09	6.02	6.17
CANet	**8.86**	**6.07**	**6.15**	**7.82**	**5.88**	**5.98**

Method	ISTD			SRD		
	S	N	A	S	N	A
CANet w/ TM	9.62	6.33	6.98	8.44	6.58	6.89
CANet w/ MNet	9.16	6.20	6.52	8.17	6.21	6.35
CANet w/o CFT	10.11	6.88	7.54	9.28	6.35	6.96
CANet w/ DRCF	9.15	6.21	6.56	8.10	6.11	6.25
DenseUNet	10.22	7.02	7.58	10.44	6.71	7.28
CANet	**8.86**	**6.07**	**6.15**	**7.82**	**5.88**	**5.98**

From left to right are input images, the results of Guo, Zhang, STC-GAN, DSC, ARGAN, RIS-GAN, CANet, and the corresponding ground truth.

Results in Complex Real-World Images

7 Failure Case

Failure cause: When there is no strong contextual correlation between shadow and non-shadow regions, such as the red rectangular area in the image.

Key References

[Guo] R. Guo et al. Single-image shadow detection and removal using paired regions. CVPR, 2011.
[Zhang] L. Zhang et al. Shadow remover: Image shadow removal based on illumination recovering optimization. TIP, 2015.
[ST-CGAN] J. Wang et al. Stacked conditional generative adversarial networks for jointly learning shadow detection and shadow removal. CVPR, 2018.
[DSC]X. Hu et al. Direction-aware spatial context features for shadow detection and removal. CVPR, 2018.
[ARGAN] B. Ding et al. Attentive recurrent generative adversarial network for shadow detection and removal. ICCV, 2019.
[RIS-GAN] L. Zhang et al. Ris-gan: Explore residual and illumination with generative adversarial networks for shadow removal. AAAI, 2020.