Image De-raining Using a Conditional Generative Adversarial Network

paper_reading_week3

Guoting Lin

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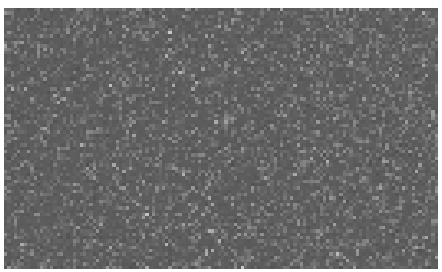
图像deraining的主流方法

1.纯物理模型的方法

2.基于稀疏编码字典学习和分类器的方法

2.1稀疏编码当作一个数据的预处理，然后将处理后的稀疏数据放入一个卷积神经网络去进行学习

2.2使用有雨的图直接进行字典学习和稀疏编码，学习的过程中，它设定了一个假设：即假设雨水和背景的特征是可分的，通过不断进行对字典和编码的优化，最终把一个图片分成一个字典的两个编码之和，这两个编码分别代表雨水的编码和背景的编码。



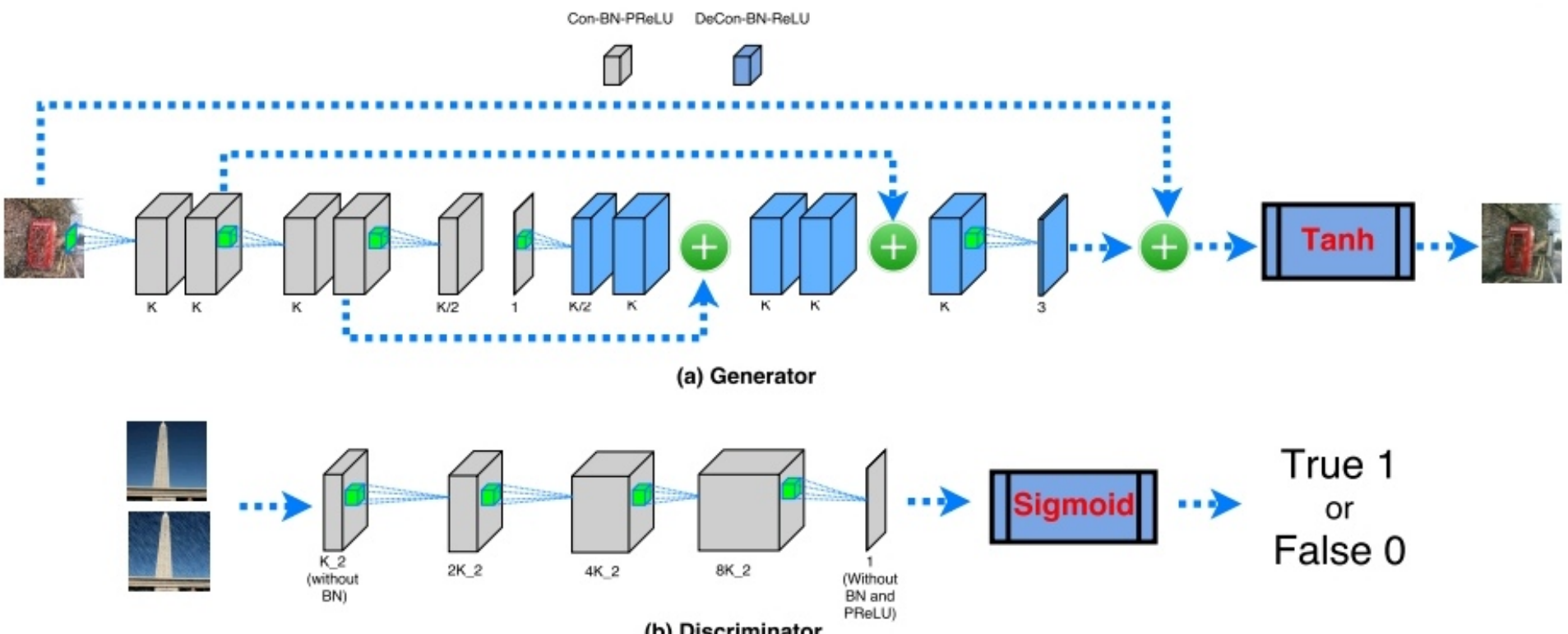
3.基于卷积神经网络的深度去雨

ID-CGAN

- 1. No additional image processing.
- 2. Include discriminative factor into optimization.
- 3. Consider visual performance into optimization.

A new perceptual loss function is defined to be used in the optimization task

generator network:
CBP(K)-CBP(K)-CBP(K)-CBP(K)-CBP(K/2)-CBP(1)-DBR(K/2)-DBR(K)-DBR(K)-DBR(K)-DBR(K)-DBR(3)-Tanh
discriminator network:
CB(K 2)-CBP(2K 2)-CBP(4K 2)-CBP(8K 2)-C(1)-Sigmoid



Refined perceptual loss functions

$$L_{RP} = L_E + \lambda_a L_A + \lambda_p L_P,$$

L E : per-pixel loss L A : adversarial loss L P : perceptual loss

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$$L_E = \frac{1}{CWH} \sum_{c=1}^{C} \sum_{x=1}^{W} \sum_{y=1}^{H} \|\phi_E(\mathbf{x}^{c,w,h}) - (\mathbf{y}_b^{c,w,h})\|_2^2,$$

$$L_A = -\frac{1}{N} \sum_{i=1}^{N} \log(D(\mathbf{y}_i)).$$

$$L_P = \frac{1}{C_i W_i H_i} \sum_{c=1}^{C_i} \sum_{w=1}^{W_i} \sum_{h=1}^{H_i} \|V(\phi_E(\mathbf{x}^{c,w,h})) - V(\mathbf{y}_b^{c,w,h})\|_2^2,$$

- **GEN: λ _A=0, λ _P=0**

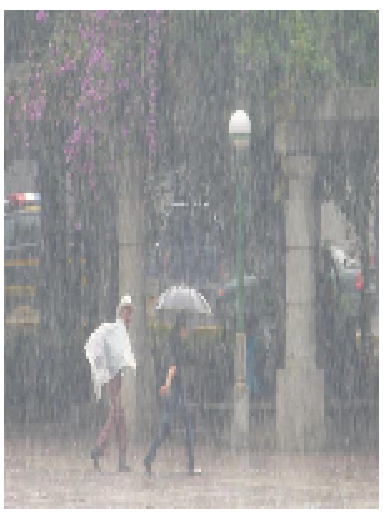
traditional CNN architecture with Euclidean loss.

- **CGAN: λ _P=0**

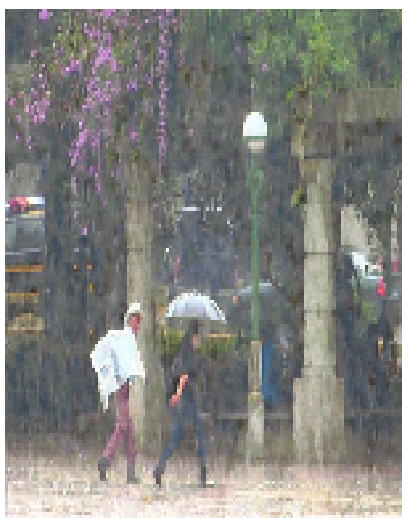
Conditional GAN structure

- **CGAN-P: λ _E=0**

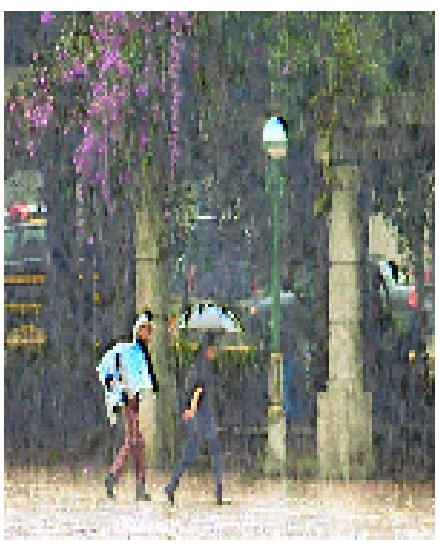
Conditional GAN is trained using perceptual loss



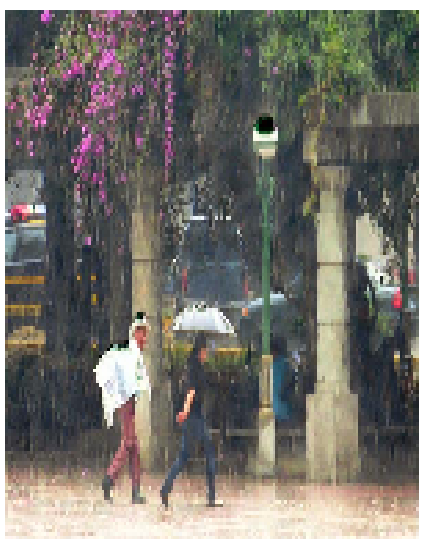
input_image



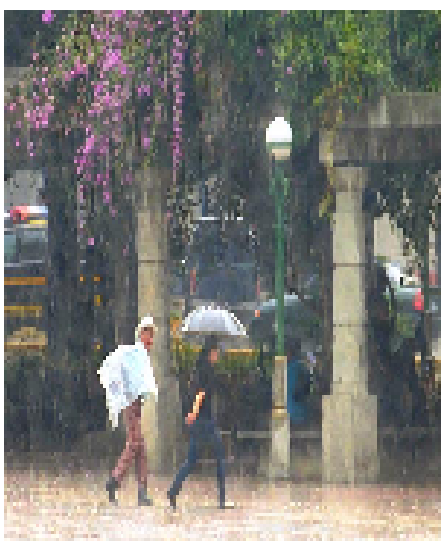
GEN



CGAN



CGAN_P



ID-CGAN

Quality measures

- 峰值信噪比（PSNR）
- 结构相似性指数（SSIM）
- 通用质量指数（UQI）
- 视觉信息保真度（VIF）

	GEN	CGAN	CGAN-P	ID-CGAN
PSNR (dB)	22.45	22.05	22.37	**22.73**
SSIM	0.7292	0.7567	0.8053	**0.8133**
UQI	0.5280	0.5368	0.6335	**0.6449**
VIF	0.3042	0.3634	0.4052	**0.4148**

- **Dataset**

1.Synthetic dataset(Photoshop)

training set:700(500 from UCID dataset,200 from BSD-500)

test set:100(UCID,BSD-500)

2.Real-world rainy images dataset:50

Comparison with state-of-the-art

- SPM: Sparse dictionary-based method
- DSC: Discriminative sparse coding-based method
- PRM: PRM prior-based method
- GMM: GMM-based method
- CCR: Convolutional-coding based method
- CNN: CNN-based method

Input

Ground Truth

SPM

PRM

DSC

CNN

GMM

IDCGAN