Deep Image Denoising

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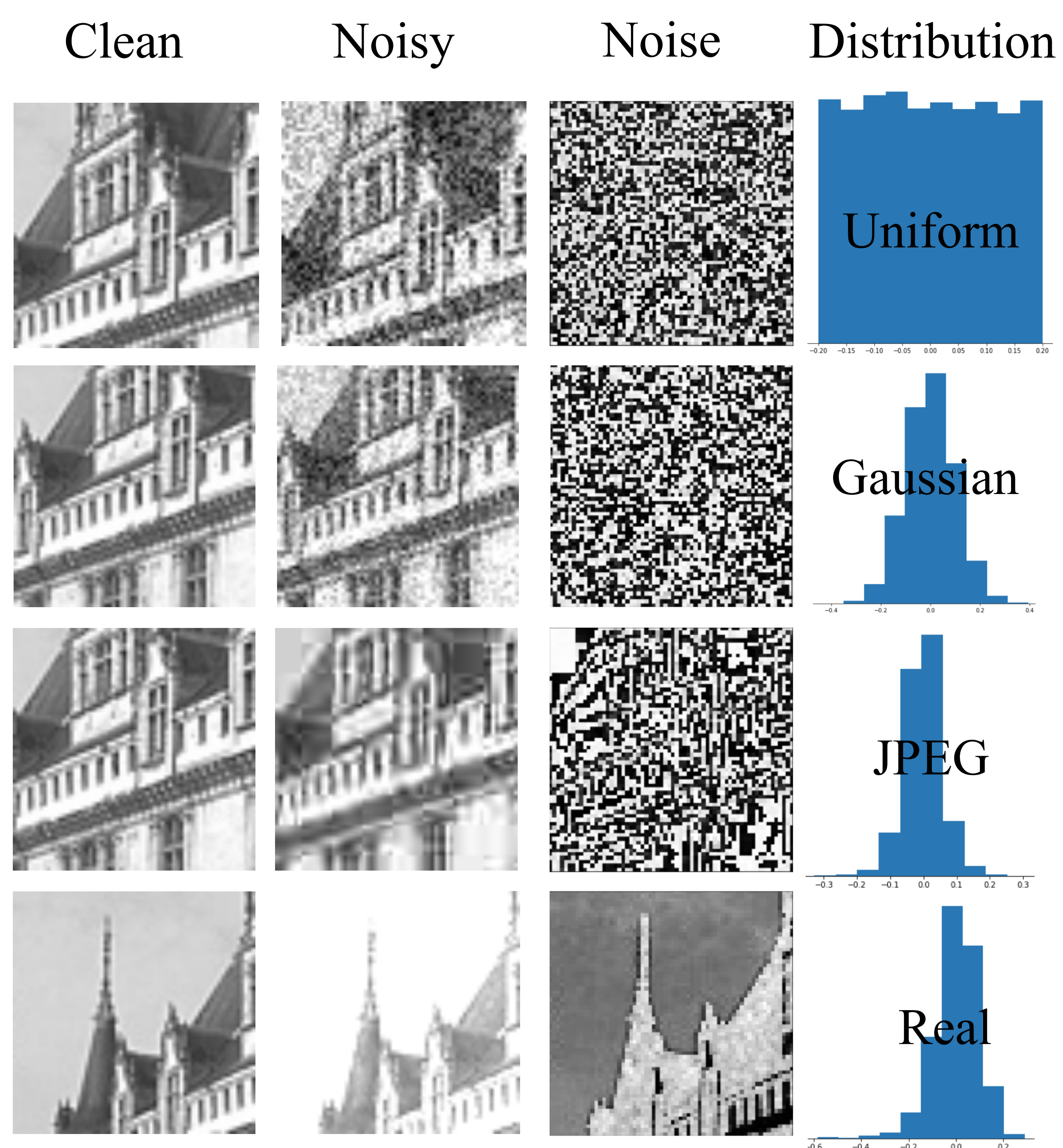
Introduction

Our project aimed to denoise images using Denoising Convolutional Neural Network (DnCNN). We trained five denoising models based on five different types of noises: uniform noise, single and mixed Gaussian noise, JPEG noise and real noise. Since there was no pure clean image in reality, looking for a paired training dataset was hard to derive.

Noises



	Uniform	Single Gaussian	Mixed Gaussian	JPEG
Parameters	~ (-0.2, 0.2)	σ = 0.1	σ ∈ [0, 0.2]	10% Quality

Methods

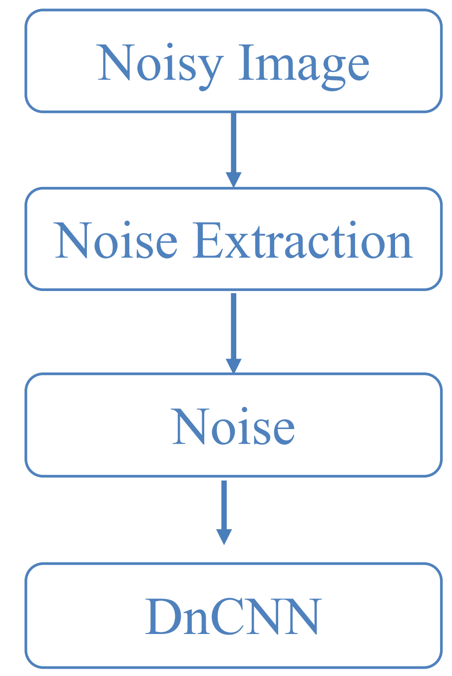


Figure 1

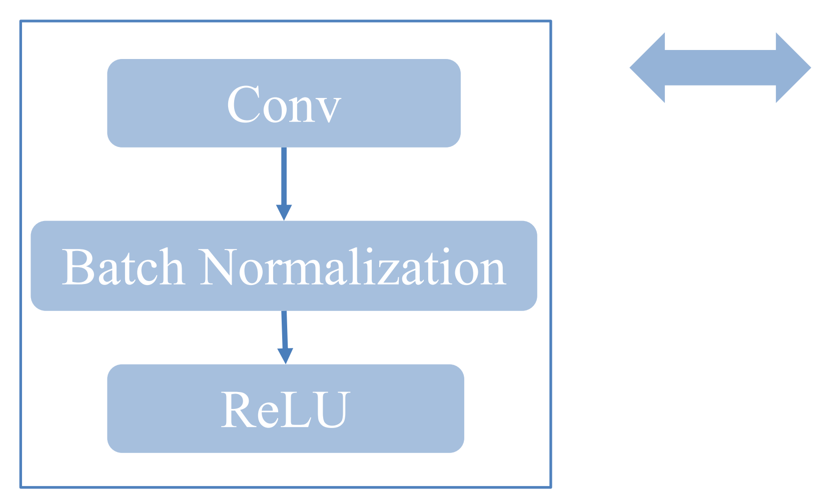


Figure 3

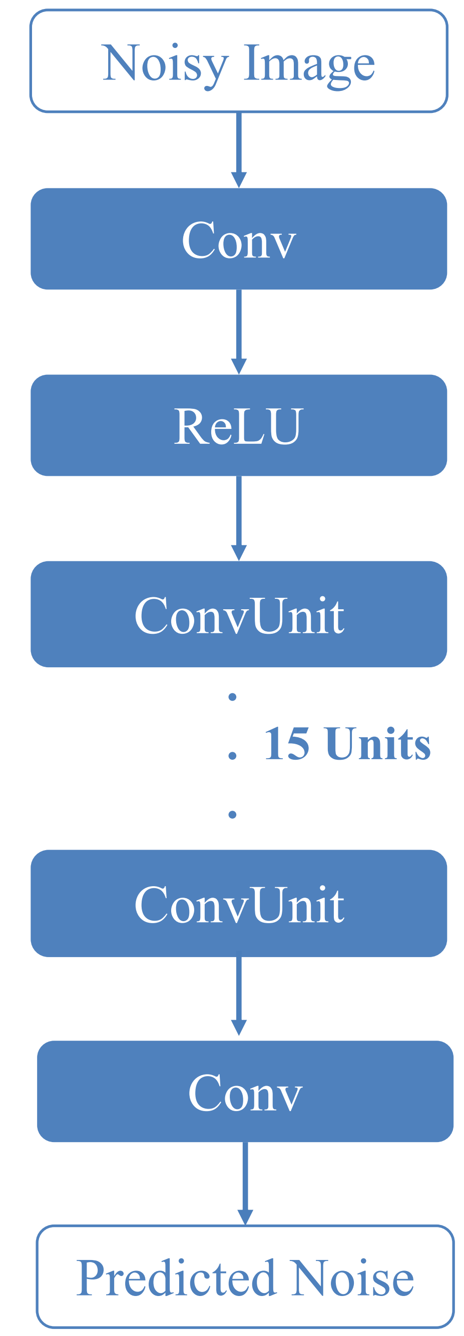


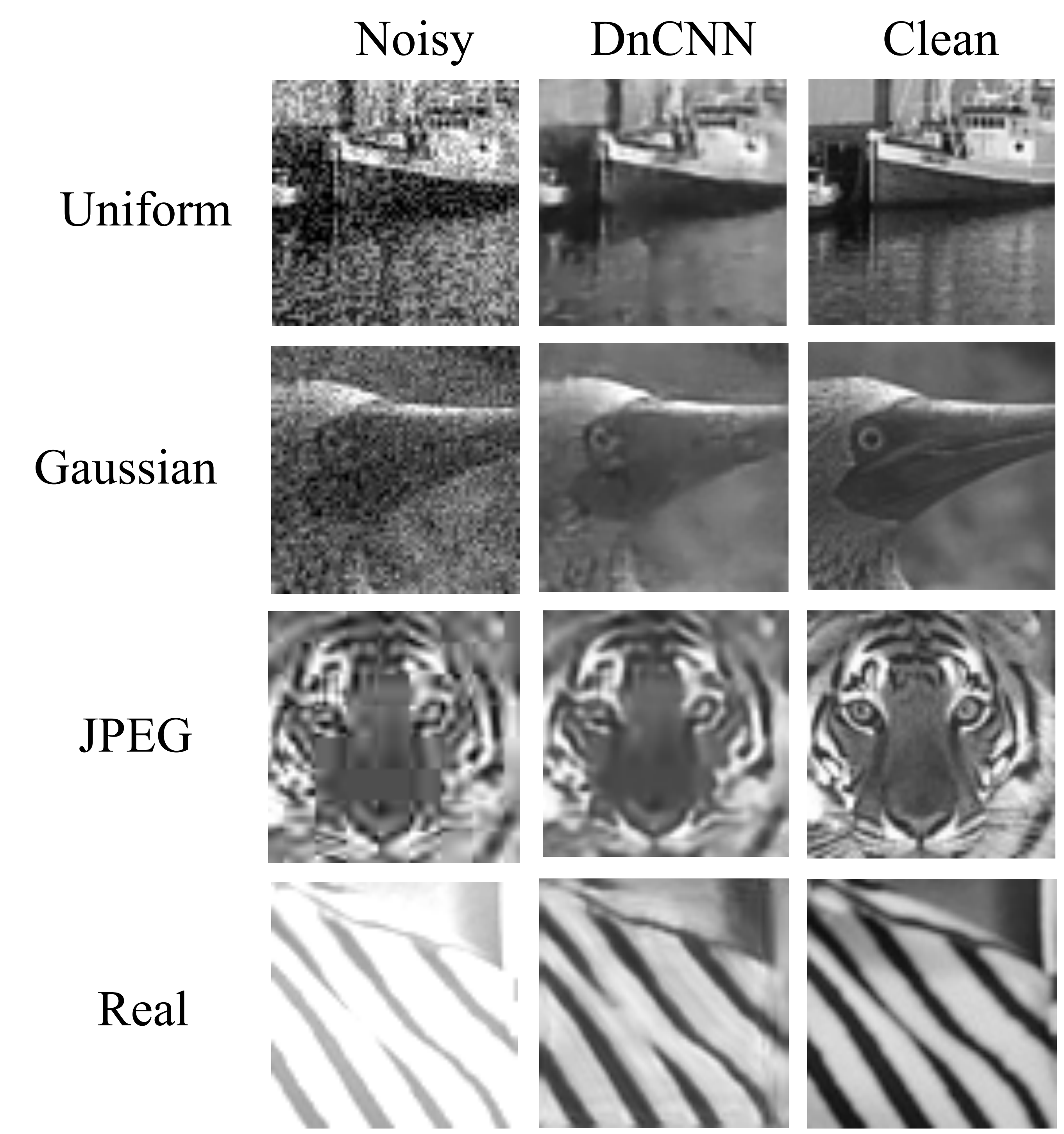
Figure 2

Figure 1 shows the overall pipeline of our project. In noise generation, we assumed the BSD68 dataset as the clean image and extracted different noise patterns from the DnD dataset.

Figure 2 shows the structure of the DnCNN network. DnCNN took noisy images (64*64) as input and output the difference between the input and the latent clean image. The predicted clean images were obtained by subtracting the output from the input.

Figure 3 shows the constitution of a ConvUnit: a Conv layer, a batch normalization layer, and a ReLU activation layer.

Results



	Noisy and Clean		DnCNN and Clean	
	PSNR	SSIM	PSNR	SSIM
Uniform	17.177dB	0.377	25.736dB	0.844
Single Gaussian	20.304dB	0.530	25.742dB	0.853
Mixed Gaussian	20.302dB	0.527	23.296dB	0.850
JPEG	27.638dB	0.853	27.165dB	0.857
Real	11.709dB	0.688	18.878dB	0.742

References

[1] Chen, J., Chen, J., Chao, H. and Yang, M., 2018. Image blind denoising with generative adversarial network based noise modeling. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition* (pp. 3155-3164).

[2] K.Zhang,W.Zuo,Y.Chen,D.Meng,andL.Zhang.Beyond a gaussian denoiser: Residual learning of deep CNN for im- age denoising. *IEEE Trans. Image Processing*, 26(7):3142– 3155, 2017