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Convolutional Neural Network with Inception Blocks for Image Compression Artifact Reduction

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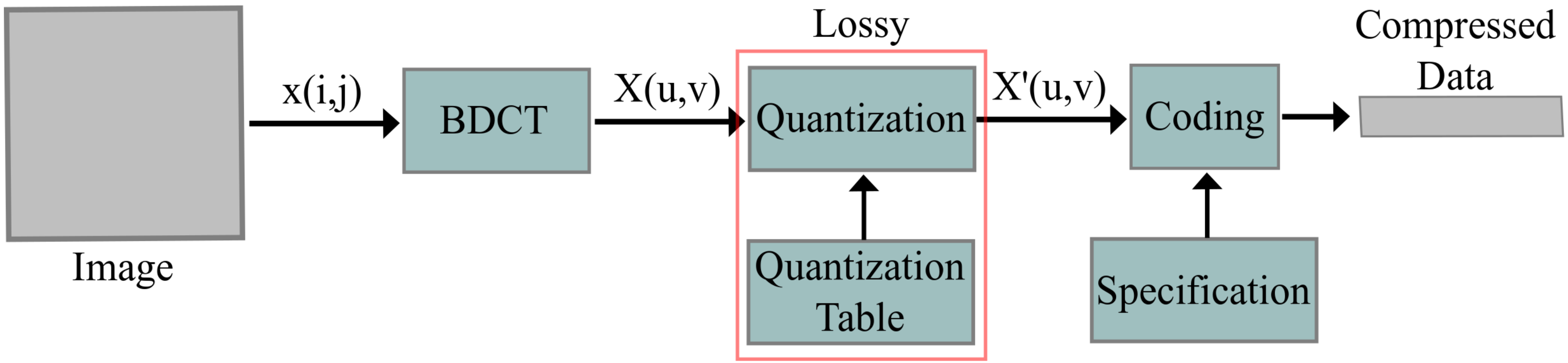
Introduction

- JPEG performs a lossy compression of an image based on quantization and coding of its BDCT coefficients.
- Different compression ratios invoke different quantization tables.
- For higher compression ratios, aggressive quantization leads to multiple artifacts.



JPEG Artifacts

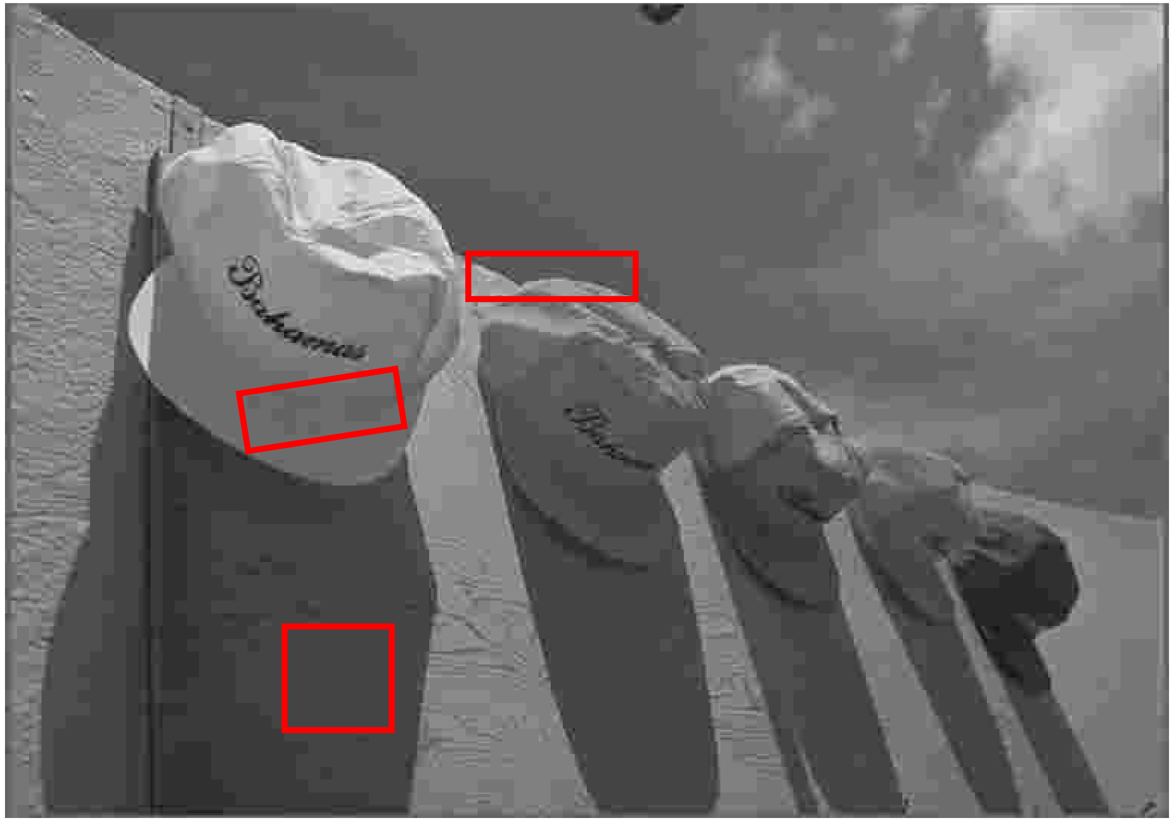
- High compression ratios lead to the following major artifacts.

  - Blurring of image patches - Suppression of high frequency information due to low bit allocation, leads to redundant pixels.

  - Blocking artifacts – Non overlapping block based transform and independent quantization leads to visible discontinuities along block edges.

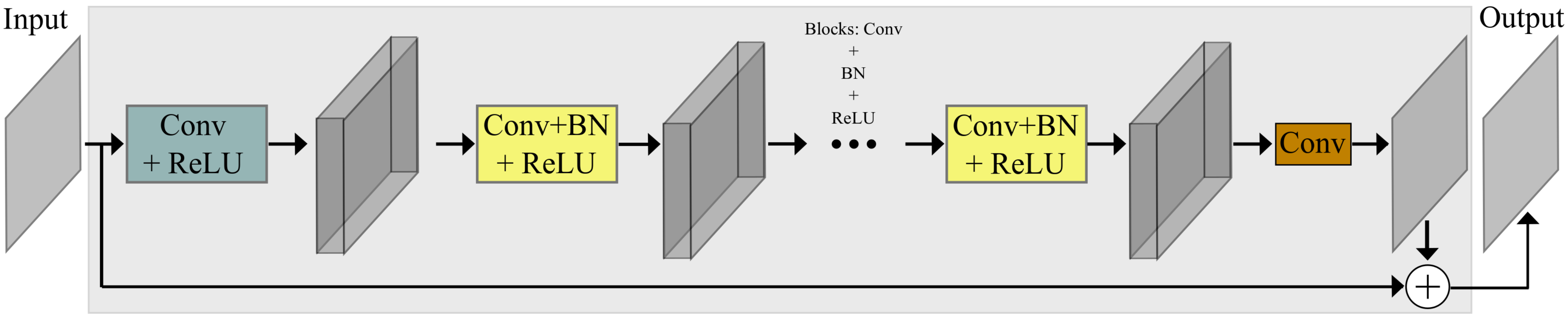
  - Ringing – Poor quantization of high frequency information leads to a coarse transition across object boundaries and introduces artifacts.

JPEG Artifacts

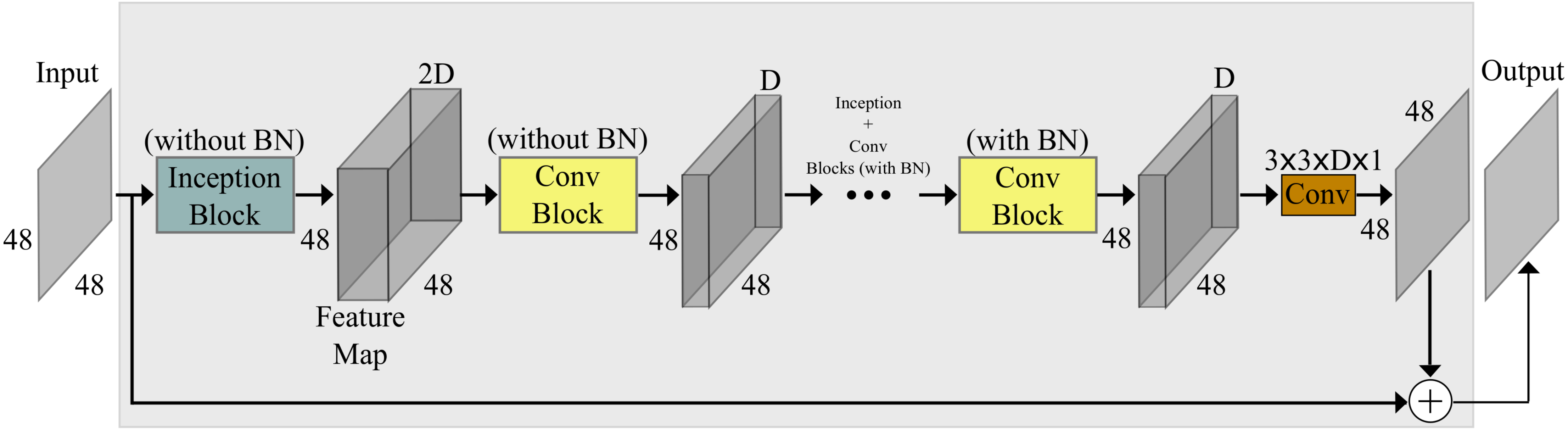
Original	JPEG (Quality: 10)
	

Basis Network

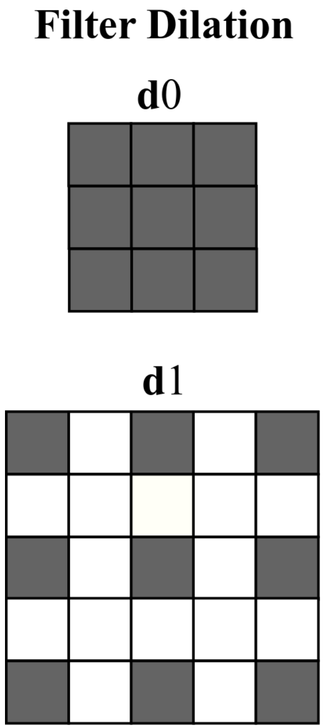
- Example based deep learning models are efficient in reducing these artifacts and restoring the image.
- Supervised convolutional neural networks (CNNs) trained particularly for image restoration problems have outperformed classical image restoration methods.
- The basis network known as Denoising CNN (DnCNN) is a residual CNN model with batch normalization (BN) for image enhancement, introduced by Zhang et.al.

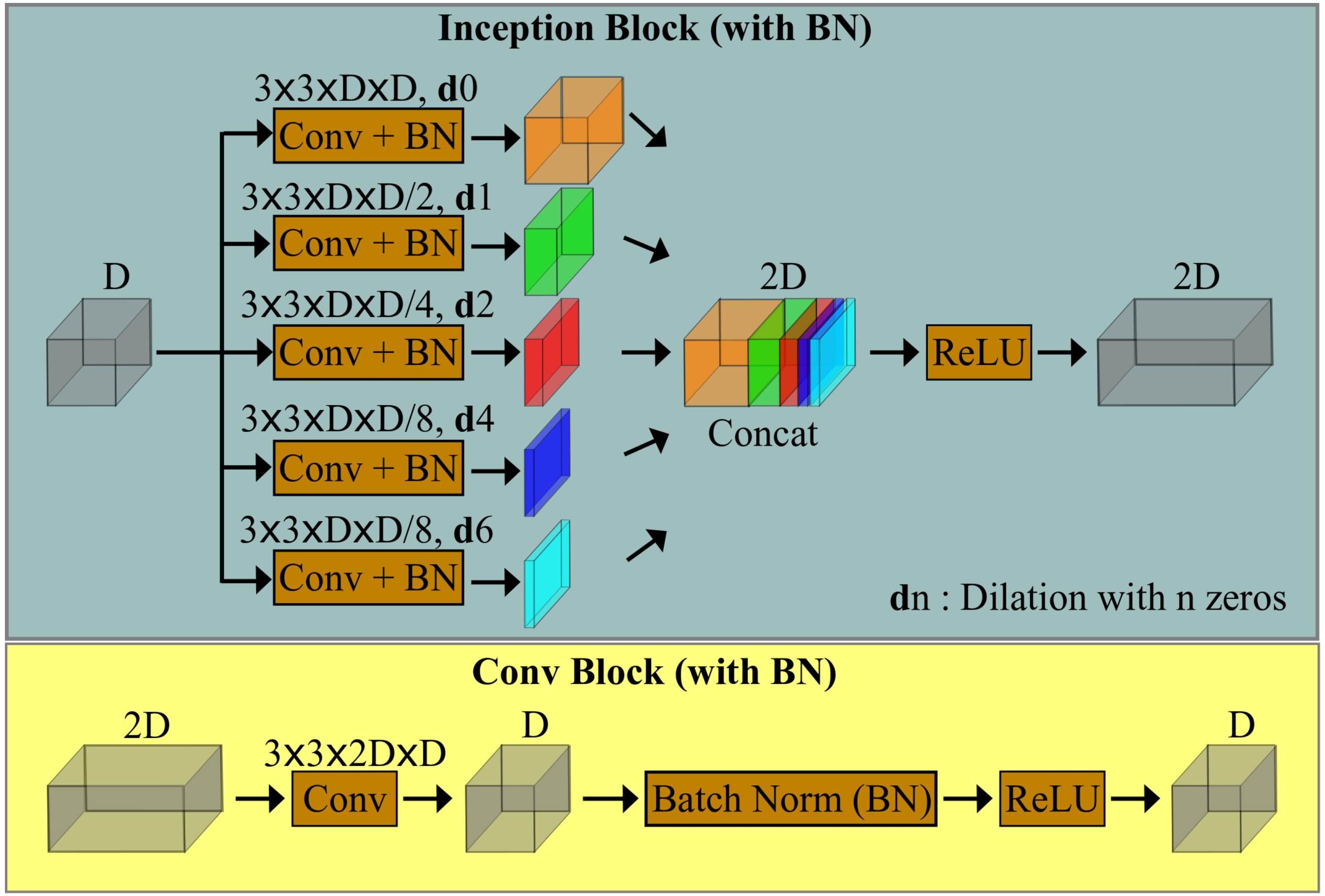


Proposed Network



Network Modules

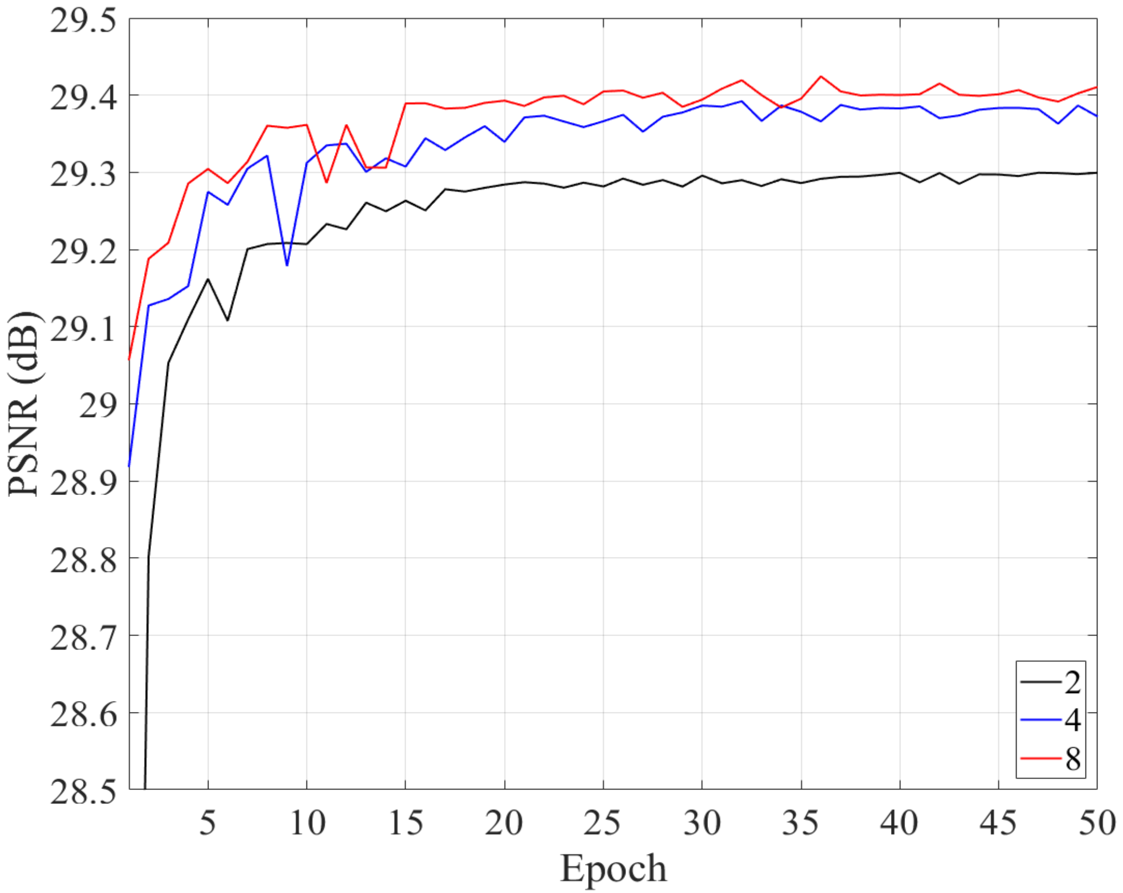




Experiments

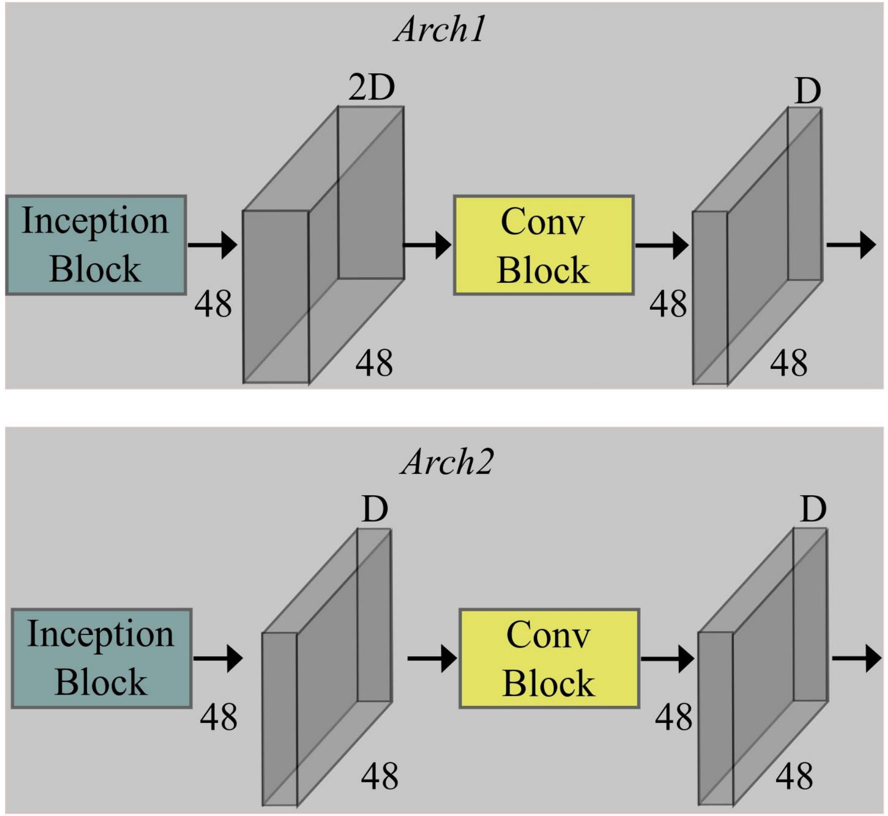
Performance over network depth

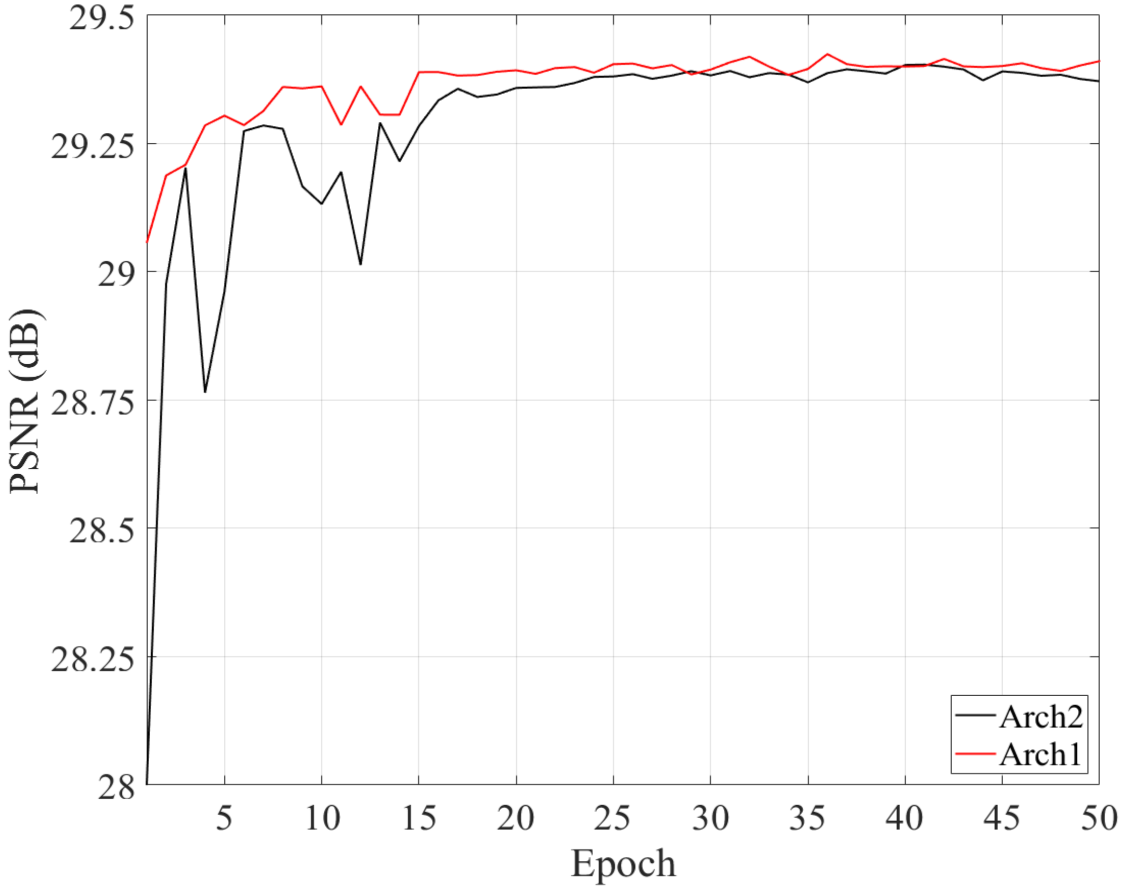
	Classic5		LIVE1	
# Incp+Conv Blocks with BN	PSNR (dB)	SSIM	PSNR (dB)	SSIM
2	29.46	0.805	29.28	0.814
4	29.53	0.808	29.33	0.816
8	29.56	0.809	29.35	0.817



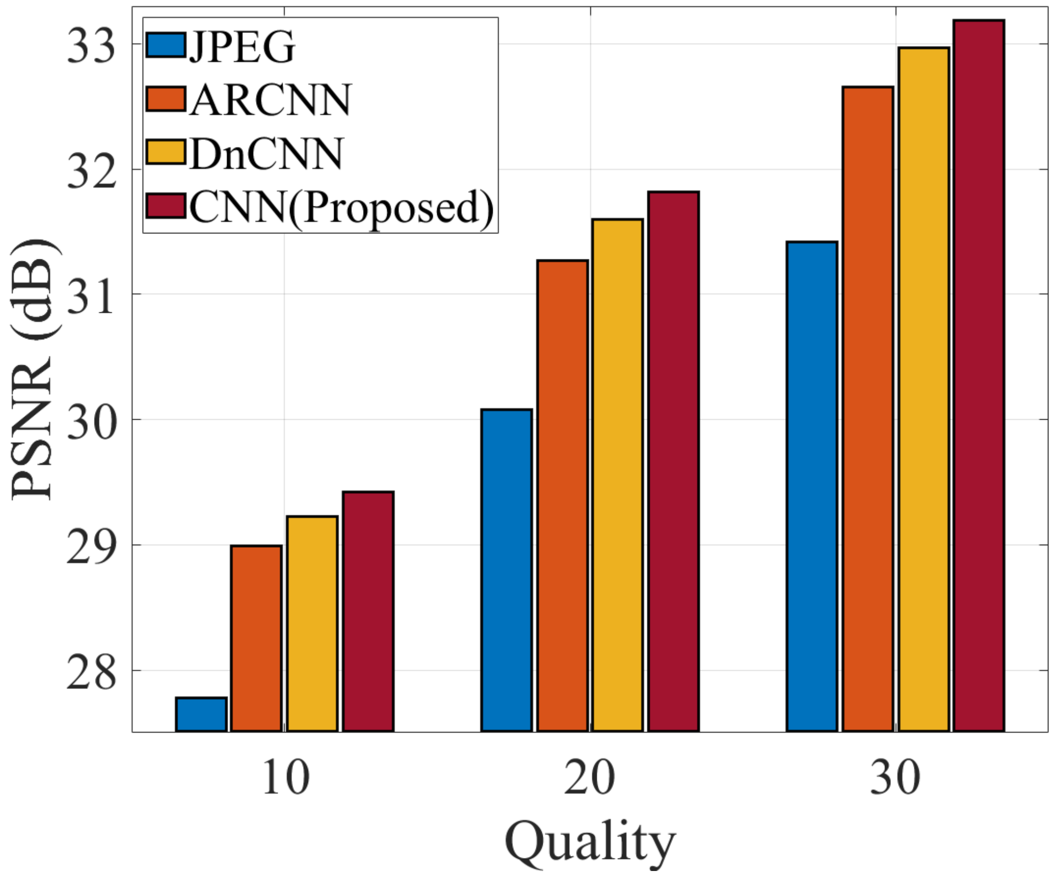
Experiments

Performance over feature map depth

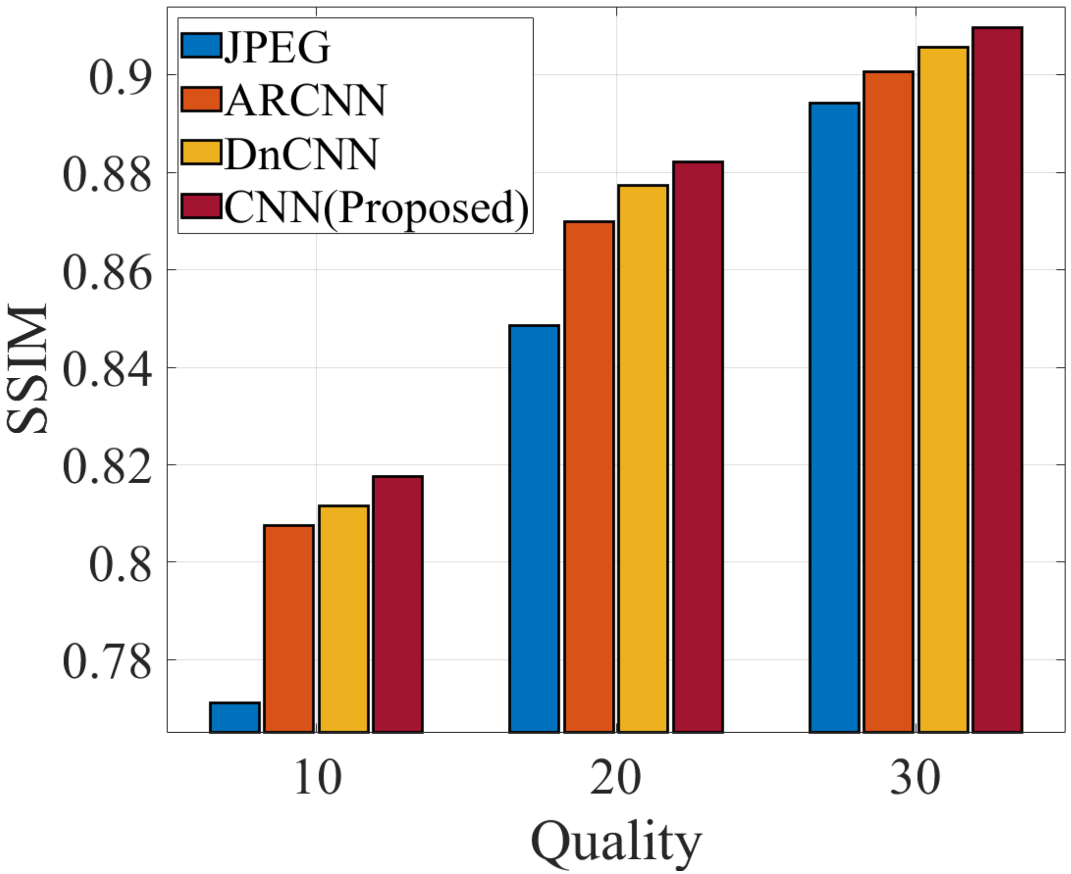




Results



JPEG
ARCNN
DnCNN
CNN(Proposed)
PSNR (dB)
28
29
30
31
32
33
10
20
30
Quality



JPEG
ARCNN
DnCNN
CNN(Proposed)
SSIM
0.78
0.8
0.82
0.84
0.86
0.88
0.9
10
20
30
Quality

Results

Original	JPEG (Quality: 10)	DnCNN	CNN (Proposed)

Conclusion

Summary

- Introduction of inception blocks in the basis network improves the restoration task.
- Parallel convolutions with filters of multiple resolution aggregate multiscale context.
- Dilated convolution increases the receptive field but not the number of filter parameters.
- The performance improves with increasing network and feature map depths.

Future Work

- Further improvements can be obtained by introducing dense skip connections, recursive blocks and improved inception modules.
- Such an approach can be applied to other enhancement tasks like superresolution and impainting.