MAGNet

Magnification-Arbitrary Generative Adversarial Network for Image Super-Resolution

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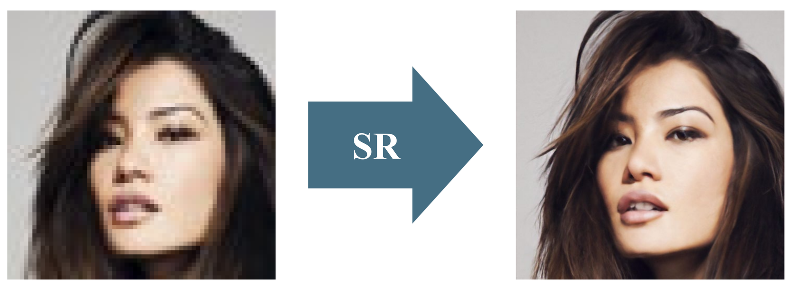
Overview

Introduction

Super Resolution (SR)

- A technique used to enhance the resolution of images
- Image generation from low to high-resolution



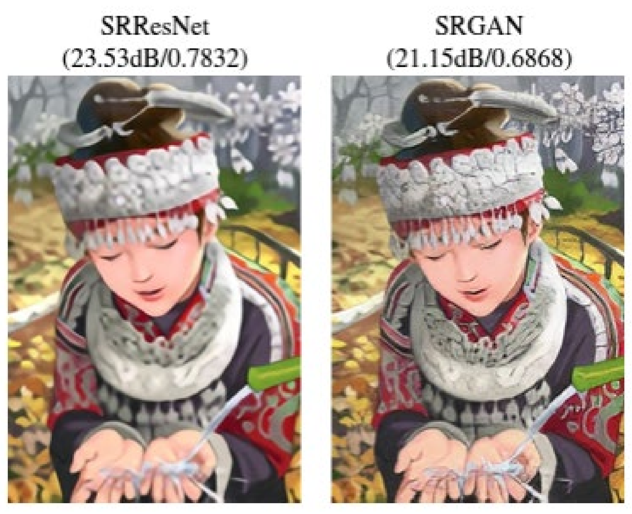
Importance of SR

- Critical for applications like medical imaging, satellite imagery, and surveillance
- Improve AI performance in detection and recognition task

Related works

ESRGAN:
Enhanced Super Resolution Generative adversarial network

- Enhanced version of **SRGAN**
- Use **Generative adversarial network (GAN)**
- Bad PSNR but looks better in the human eye
- Support only **integer scales**



Meta-SR:
Magnification-arbitrary Network for Super Resolution

- Supports **arbitrary scale** SR
- **Meta-learning:** predicts the weights of upscaling layer **only with scale factor and pixel positions**
- **Meta Upscaling Module** could apply to other SR models by replacing final upscaling process

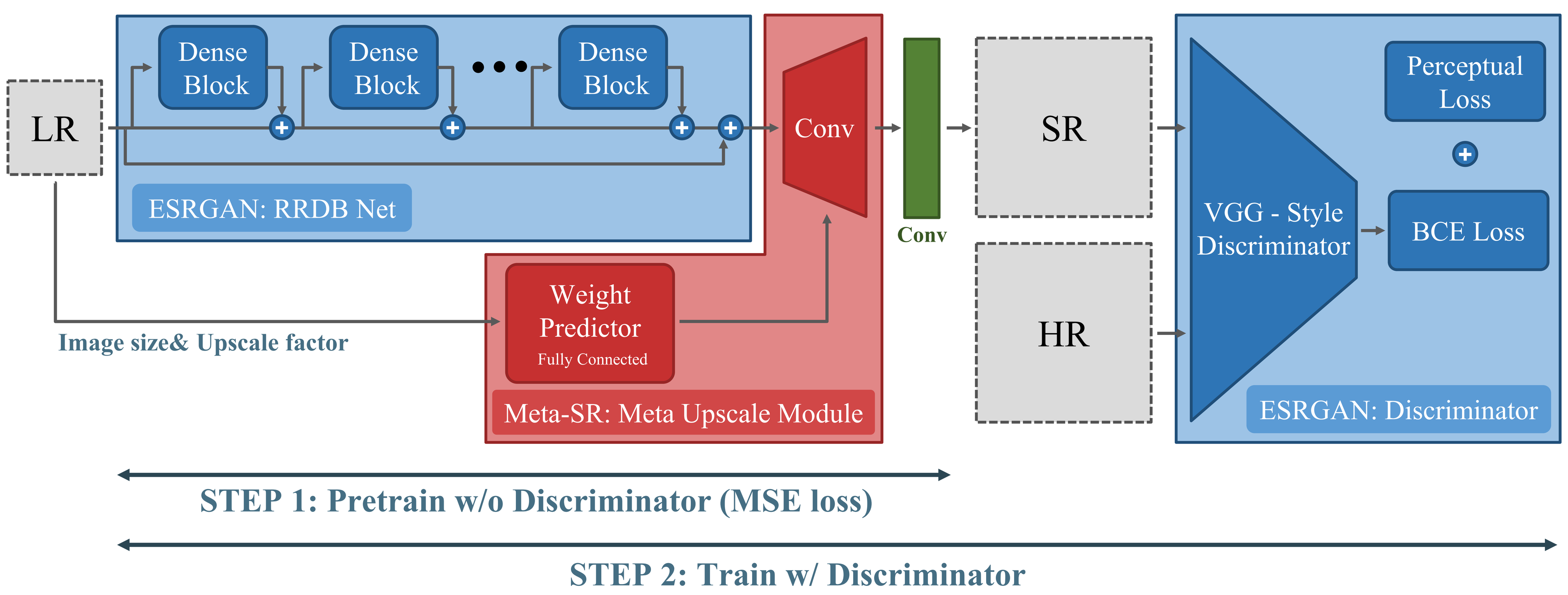
Motivation

ESRGAN: No support for **arbitrary-scale SR**
Meta-SR: Limited **high-resolution detail**

MAGNet: ESRGAN + Meta-SR Upscale Module
(high resolution) (arbitrary scale)

Methodology

Model Design



Additional Features

Non-discrete scale factor

- Randomly picked at [2, 4]
- Uniform distribution
- Beta distribution

$Beta(n,1) \sim \max_{1\le i\le n} U(0,1)$

Enhanced weight predictor

- There's only one layer in Meta-SR weight predictor
- Add more layers for prediction complexity

Denoising w/ conv. layers

- Add **2 convolution layers** after the Meta Upscale Module

Train Details

Train	Validation	Test	
DIV2K Train	DIV2K Valid	Set5	Set14

- Evaluated with **PSNR**

Results

Quantitative Analysis

vs Meta-SR (DIV2K Valid)

Original Image (LR, HR) | Meta-SR (×4) | Pretrained MAGNet (×4) (ours) | MAGNet (×4) (ours)

Impact of the Additional Features (DIV2K Valid)

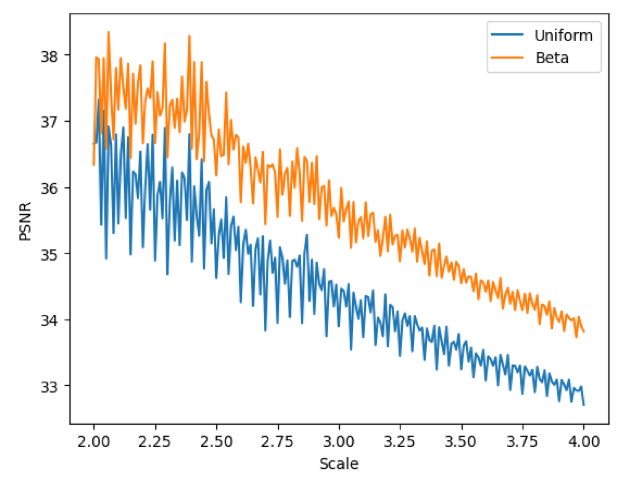
Original Image (LR, HR) | MAGNet ver.1 (×4) Uniform distribution | MAGNet ver.2 (×4) Beta distribution | MAGNet ver.3 (×4) Beta distribution + Conv. layers

vs ESRGAN (DIV2K Valid)

Original Image (LR, HR) | ESRGAN (×4) | MAGNet (×4) (ours) | (×3.14) | (×2.22)

Qualitative Analysis (PSNR)

Uniform vs Beta (DIV2K Valid)



Model Comparison (Set5+Set14)

Model	× 2.22	× 3.14
Meta-SR	34.042	31.377
ESRGAN	31.827	29.153
Pretrained MAGNet (ours)	32.164	30.172

Conclusion & Discussion

Proposed Model: MAGNet generates realistic images for any given arbitrary scale

Limitations

- Due to limited computational resources, training was constrained in terms of epochs, batch size, and dataset size
- Despite our efforts, GAN instability, combined with limited resources, introduced noise in certain images

Future works

- Extend the training duration and incorporate more extensive datasets to further validate MAGNet's capabilities
- Try advanced techniques like learning rate schedulers to enhance performance.
- Adopting more precise evaluation methods, such as Mean Opinion Score (MOS), would provide a better assessment of our model, which is designed to focus on high-resolution details

References

[1] LEDIG, Christian, et al. Photo-realistic single image super-resolution using a generative adversarial network. In: Proceedings of the IEEE conference on computer vision and pattern recognition. 2017. p. 4681-4690.
[2] WANG, Xintao, et al. Esrgan: Enhanced super-resolution generative adversarial networks. In: *Proceedings of the European conference on computer vision (ECCV) workshops*. 2018. p. 0-0.
[3] HU, Xuecai, et al. Meta-SR: A magnification-arbitrary network for super-resolution. In: *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition*. 2019. p. 1575-1584.