Fourier and Edge Loss for GAN-Based Super Resolution

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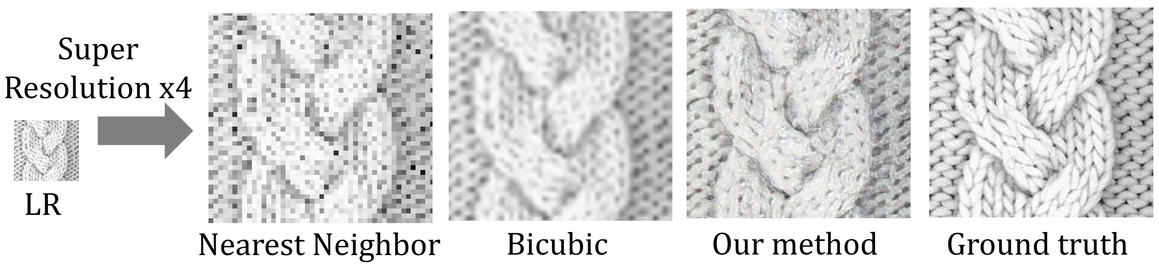
Introduction

In super resolution MSE yields too smooth results.

We present edge and Fourier loss to enforce high-frequency details and regularize GAN training.



Proposed Loss Function

MSE Loss

$$\mathcal{L}_{\mathrm{MSE}}(I_1, I_2) = \|\mathrm{I}_1 - \mathrm{I}_2\|_2^2$$

Edge Loss

$$\mathcal{L}_{\mathrm{Edge}}(I_1, I_2) = \|S(\mathrm{I}_1) - S(\mathrm{I}_2)\|_1,$$

where $S(\mathrm{I_k})$ is the Sobel filter result of $\mathrm{I_k}$.

FFT Loss

$$\mathcal{L}_{\mathrm{FFT}}(\mathrm{I}_1, \mathrm{I}_2) = \||\mathrm{F}_{\mathrm{I1}}| - |\mathrm{F}_{\mathrm{I2}}|\|_1,$$

where the Fourier transform of $\mathrm{I_k}$ is $\mathrm{I_k} \xrightarrow{\mathcal{F}} \mathrm{F_{Ik}}$.

Adversarial Loss

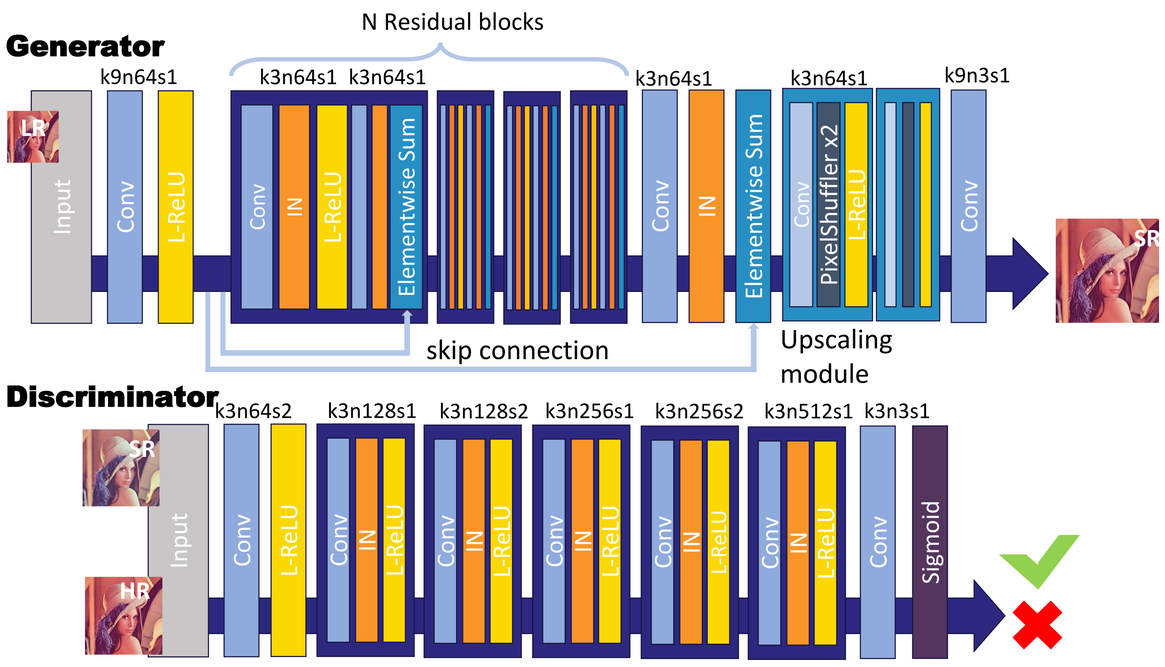
$$\mathcal{L}_{\mathrm{GAN}}(\mathrm{I}_{\mathrm{generated}}) = \log(1 - \mathrm{D}(\mathrm{I}_{\mathrm{generated}})),$$

where $\mathrm{D}(\mathrm{I_k})$ is the output of the discriminator for $\mathrm{I_k}$.

Total Loss

$$\mathcal{L}_{\mathrm{Tot}} = \mathcal{L}_{\mathrm{MSE}} + \alpha_1 \mathcal{L}_{\mathrm{Edge}} + \alpha_2 \mathcal{L}_{\mathrm{FFT}} + \alpha_3 \mathcal{L}_{\mathrm{GAN}}$$

Proposed Architecture



Results