Perceptual Losses for Real-Time Style Transfer and Super-Resolution

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content

- Target: Image Generation

- Style Transfer

- Single-image Super-Resolution
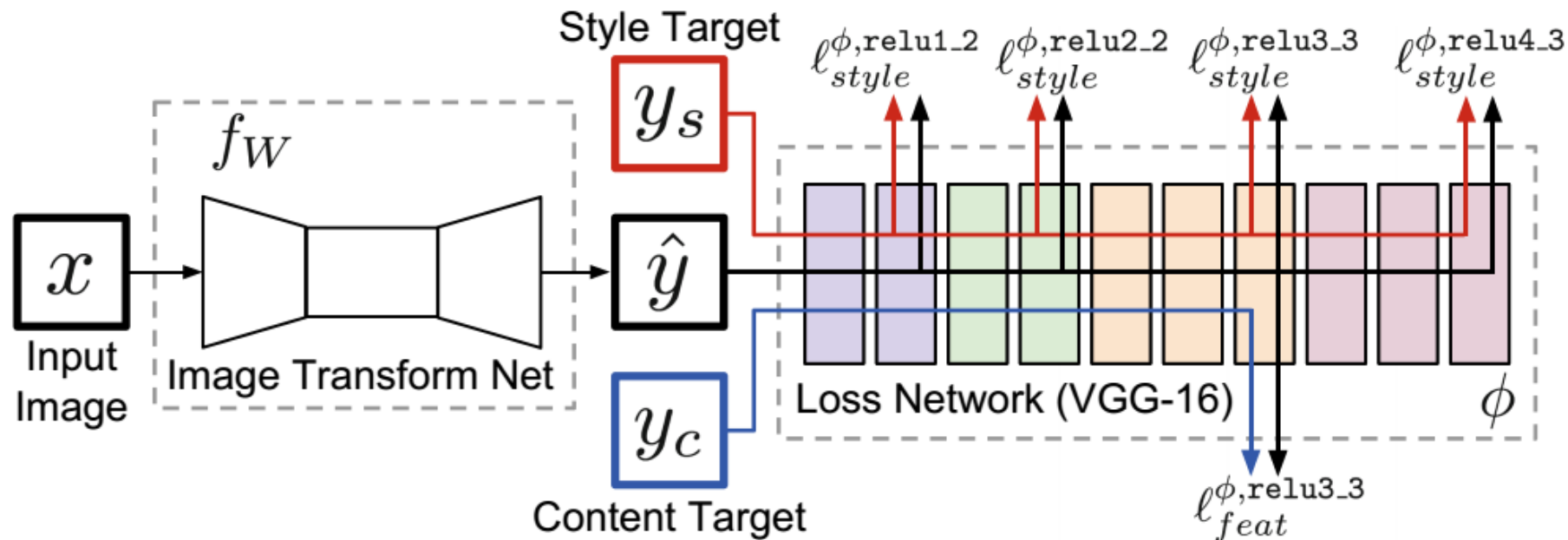
background

- CNN + pixel loss
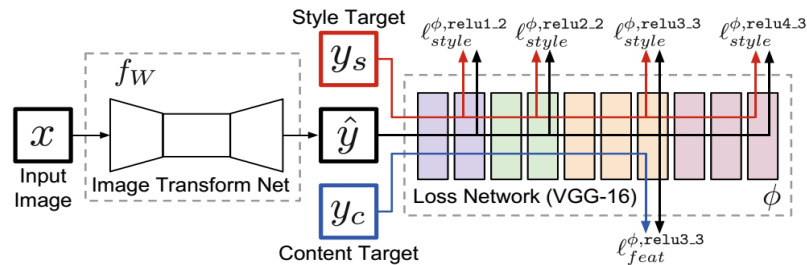

- CNN + optimizations

Architecture

- CNN + Perceptual Losses

Perceptual Losses

- Feature Reconstruction Loss

$$\ell_{feat}^{\phi,j}(\hat{y}, y) = \frac{1}{C_j H_j W_j} \|\phi_j(\hat{y}) - \phi_j(y)\|_2^2$$
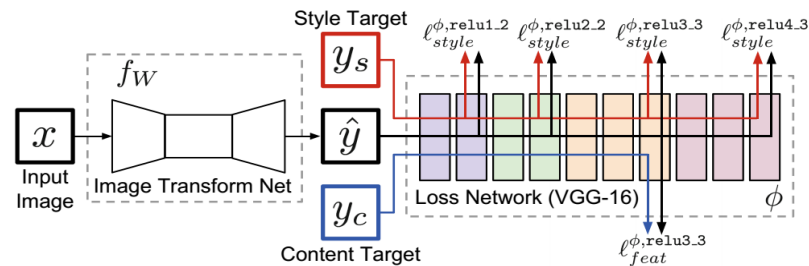
Perceptual Losses
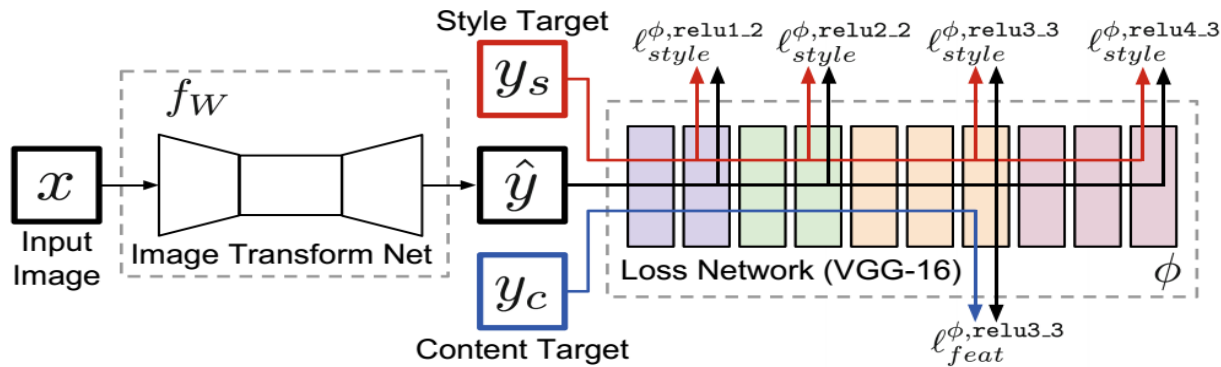

- Style Reconstruction Loss

$$\ell^{\phi,j}_{style}(\hat{y}, y) = \|G^{\phi}_j(\hat{y}) - G^{\phi}_j(y)\|^2_F.$$

$$G^{\phi}_j(x)_{c,c'} = \frac{1}{C_j H_j W_j} \sum_{h=1}^{H_j} \sum_{w=1}^{W_j} \phi_j(x)_{h,w,c} \phi_j(x)_{h,w,c'}.$$

Style Transfer

$$\hat{y} = \arg\min_y \lambda_c \ell_{feat}^{\phi,j}(y, y_c) + \lambda_s \ell_{style}^{\phi,J}(y, y_s) + \lambda_{TV} \ell_{TV}(y)$$

Style Transfer Results

Style
The Starry Night,
Vincent van Gogh,
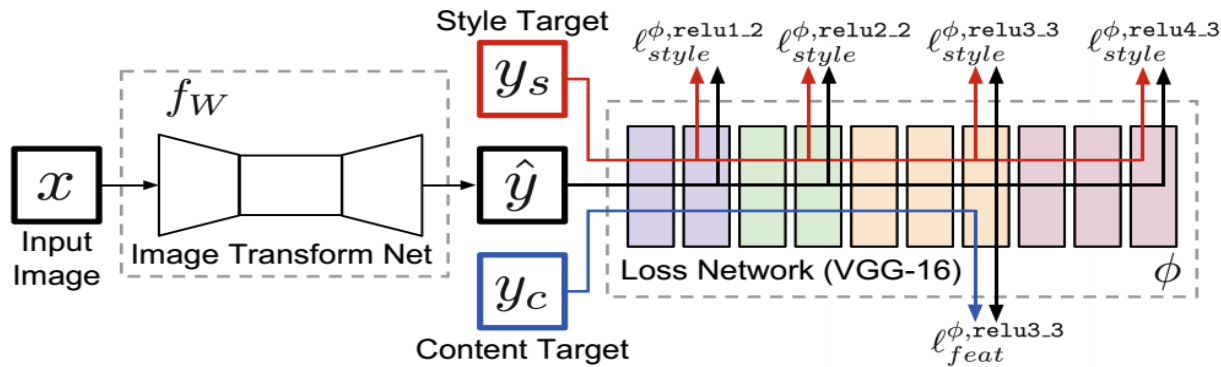1889

Style
The Muse,
Pablo Picasso,
1935

Content Gatys Ours **Content** Gatys Ours

Style Transfer Results

Image Size	Gatys			Ours	Speedup		
	100	300	500		100	300	500
256×256	3.17	9.52s	15.86s	**0.015s**	212x	636x	**1060x**
512×512	10.97	32.91s	54.85s	**0.05s**	205x	615x	**1026x**
1024×1024	42.89	128.66s	214.44s	**0.21s**	208x	625x	**1042x**

Super-Resolution

$$\ell_{style}^{\phi,J}(\hat{y},y) = \sum_{i=1}^{n} \ell_{style}^{\phi,j}(\hat{y},y)$$

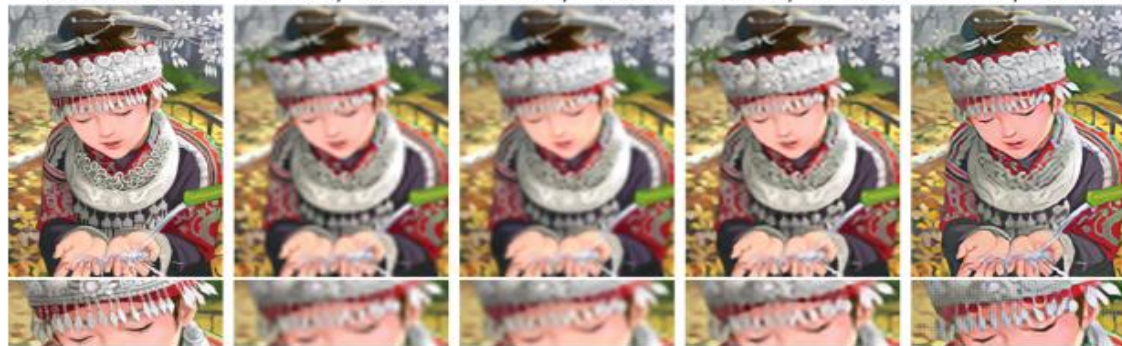$$\ell_{style}^{\phi,j}(\hat{y},y) = \|G_j^{\phi}(\hat{y}) - G_j^{\phi}(y)\|_F^2.$$

$$G_j^{\phi}(x)_{c,c'} = \frac{1}{C_j H_j W_j} \sum_{h=1}^{H_j} \sum_{w=1}^{W_j} \phi_j(x)_{h,w,c} \phi_j(x)_{h,w,c'}.$$

Super-Resolution Results

	Ground Truth	Bicubic	Ours (ℓ_{pixel})	SRCNN [13]	Ours (ℓ_{feat})
This image		31.78 / 0.8577	31.47 / 0.8573	32.99 / 0.8784	29.24 / 0.7841
Set5 mean		28.43 / 0.8114	28.40 / 0.8205	30.48 / 0.8628	27.09 / 0.7680

	Ground Truth	Bicubic	Ours (ℓ_{pixel})	SRCNN [13]	Ours (ℓ_{feat})
This Image		21.69 / 0.5840	21.66 / 0.5881	22.53 / 0.6524	21.04 / 0.6116
Set14 mean		25.99 / 0.7301	25.75 / 0.6994	27.49 / 0.7503	24.99 / 0.6731
BSD100 mean		25.96 / 0.682	25.91 / 0.6680	26.90 / 0.7101	24.95 / 63.17

THANKS

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