ESTHER: Extremely Simple Image Translation Through Self-Regularization

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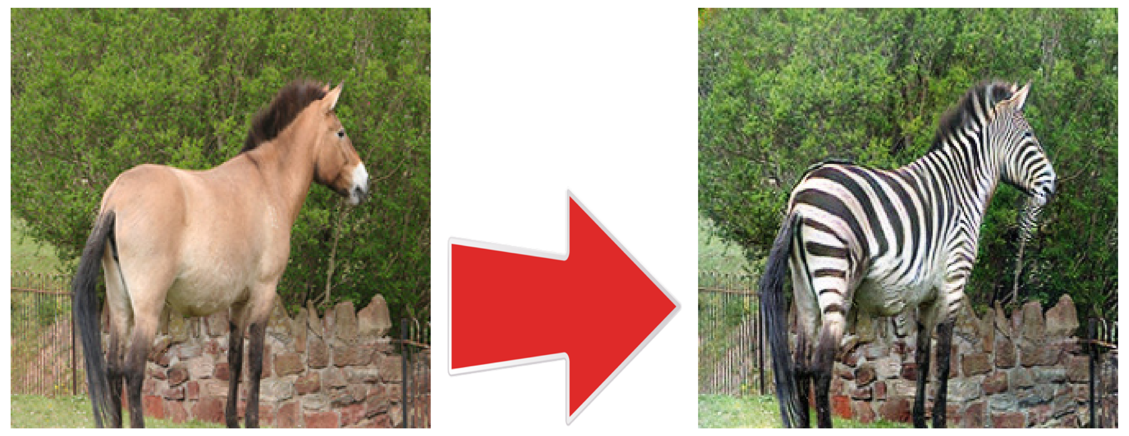
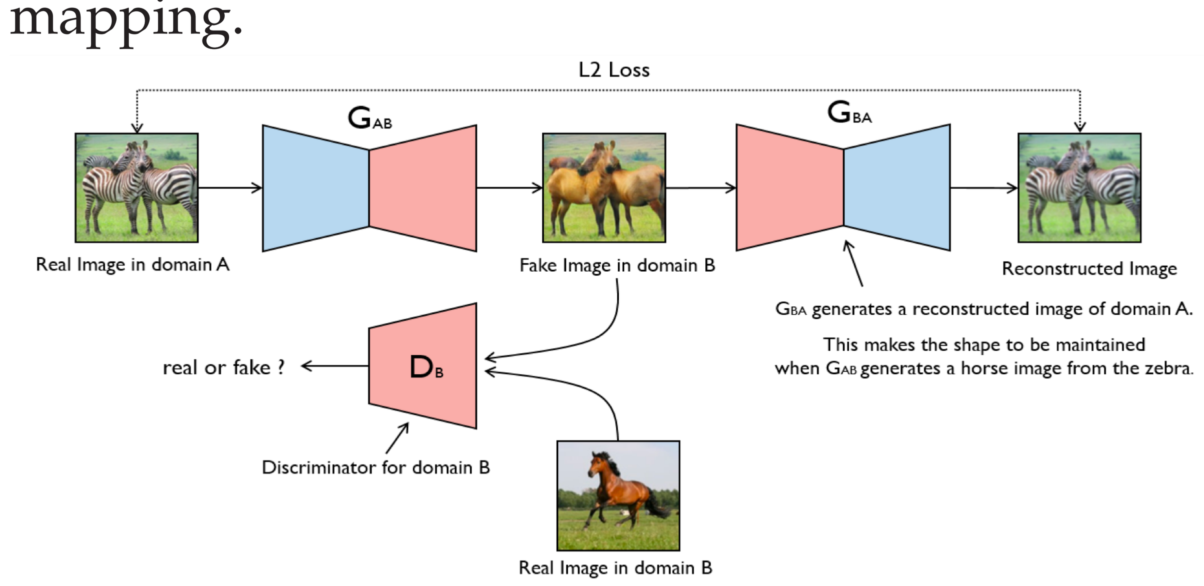
Overview



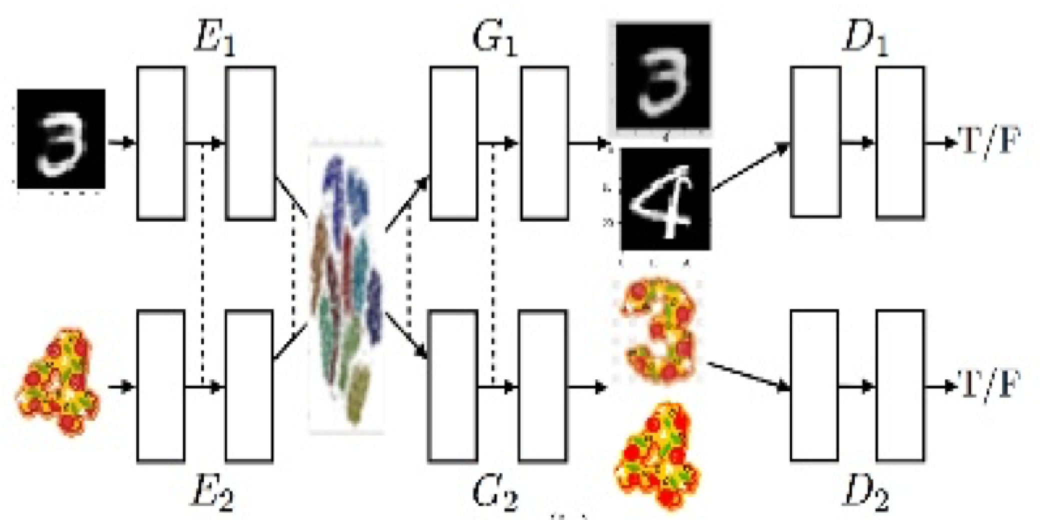
Problem: *Unpaired image translation between two domains*, where the goal is to learn the mapping from an input image in the source domain to an output image in the target domain.
Challenge: An ill-posed task (no paired data)!
Method: An extremely simple yet effective image translation approach, which consists of a *single generator* and is trained with a *self-regularization term* and an *adversarial term*.
Results: Our model achieves better performance than other methods on a broad range of tasks and applications.

Related Works

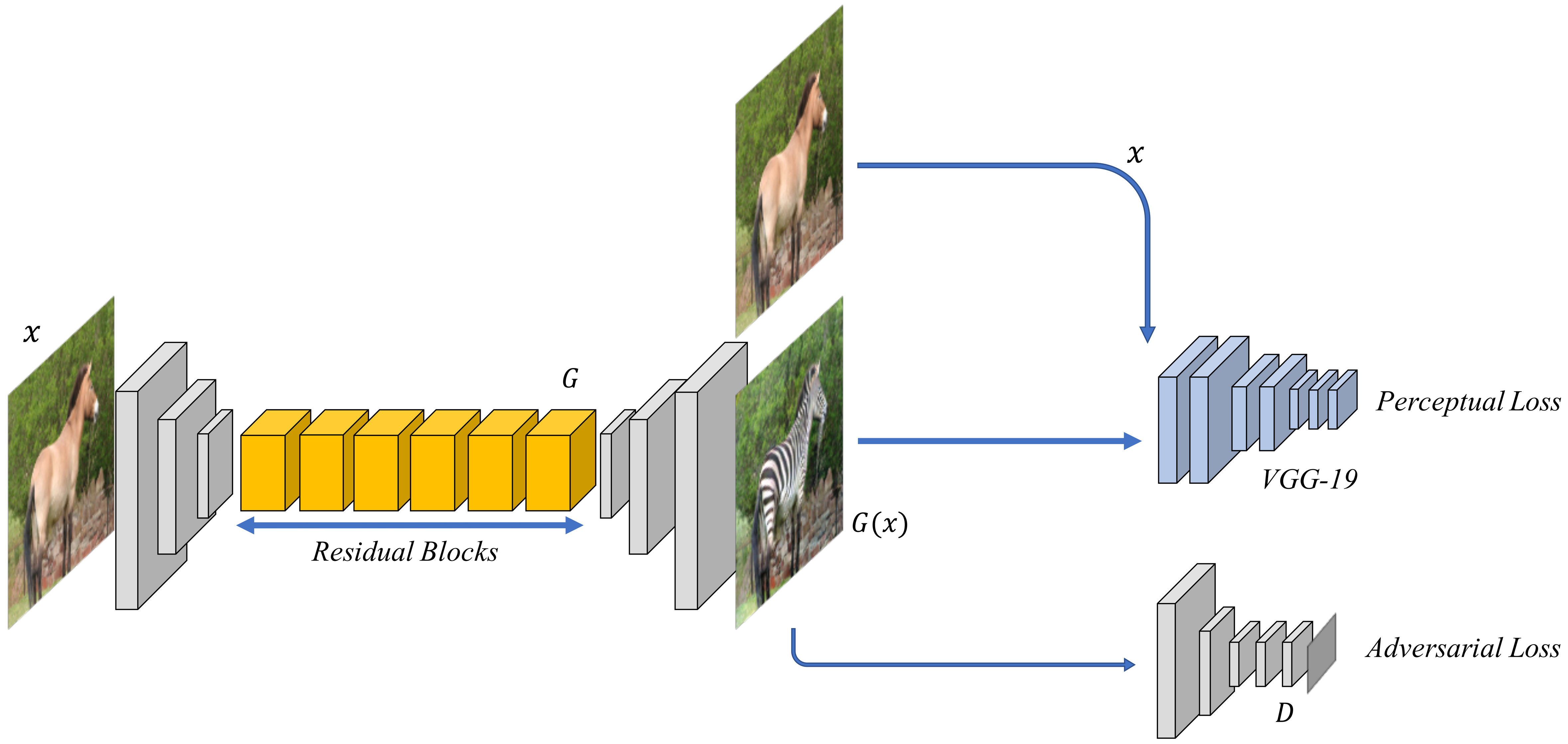
CycleGAN: relies on "laziness" of neural network and cycle-consistency to ensure 1-1 mapping.



UNIT: relies on shared latent space and cycle-consistency.



Our Model



Our model consists of a single generator G that maps an image from one domain to another domain. We train G using the self-regularization perceptual loss and the adversarial loss:

$$\mathcal{L}_G(\theta) = \ell_{adv}(G_\theta(x), Y) + \lambda \ell_{reg}(x, G_\theta(x)).$$

Training Details

Training Losses:

- Image domain adversarial loss (with PatchGAN):

$$\ell_{adv}(G_\theta(x), Y) = E_{y\sim Y}[\log D(y)] + E_{x\sim X}[\log(1 - D(G(x)))].$$

- The self-regularization loss (with Perceptual Loss):

$$\ell_{reg}(y', x) = \sum_{l=1}^{3} \frac{1}{H_l W_l} \sum_{h,w} (\| w_l^T \circ (\hat{F}(x)_{hw}^l - \hat{F}(y')_{hw}^l) \|_2^2).$$

Notes: we use VGG-19 pre-trained on ImageNet as F. We obtained the best results by using the first three layers of VGG-19, which preserves the low-level traits of the input during translation.

Domain Adaptation Results

From photo to maps:

Method	Accuracy
Pix2Pix	43.18%
CycleGAN	45.91%
Ours	**46.72%**

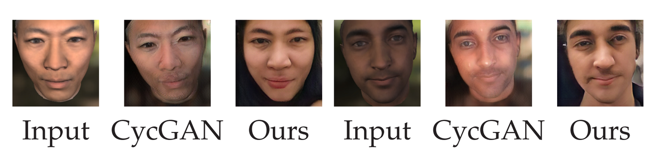
Figure 1: Visualization (left) and quantitative evaluation (right) of image to map translation results.

From MNIST to USPS and MNIST-M:

Method	USPS	MNIST-M
CoGAN	95.65%	-
PixelDA	95.90%	98.20%
UNIT	95.97%	-
CycleGAN	94.28%	93.15%
Target-only	96.50%	96.40%
Ours	**96.80%**	**98.33%**

Figure 2: Visualization (left) and quantitative evaluation (right) of domain adaptation from MNIST to USPS and MNIST-M.

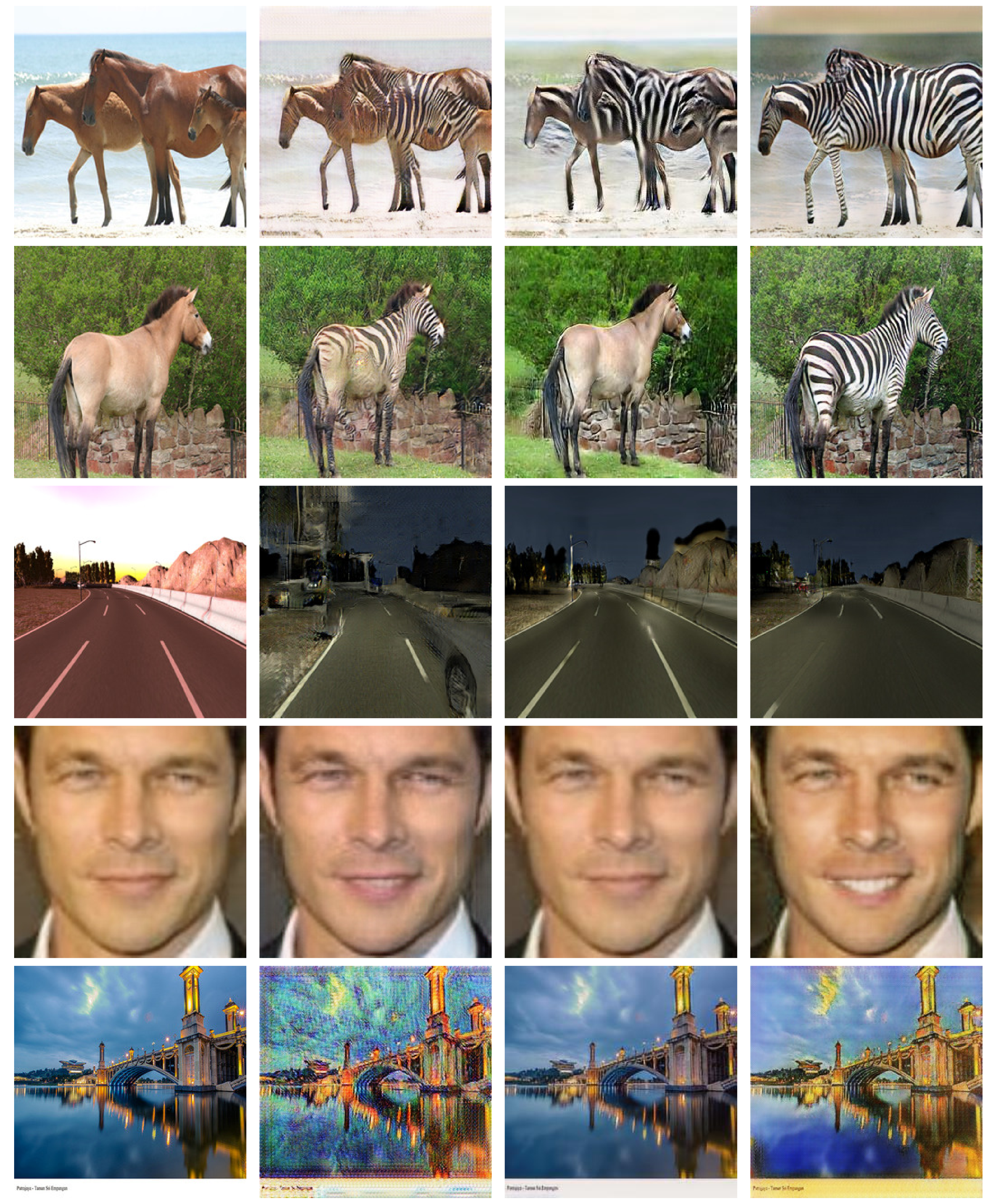
From rendered face to real face:



Method	MSE
Baseline	2.26
CycleGAN	2.04
Ours	**1.97**

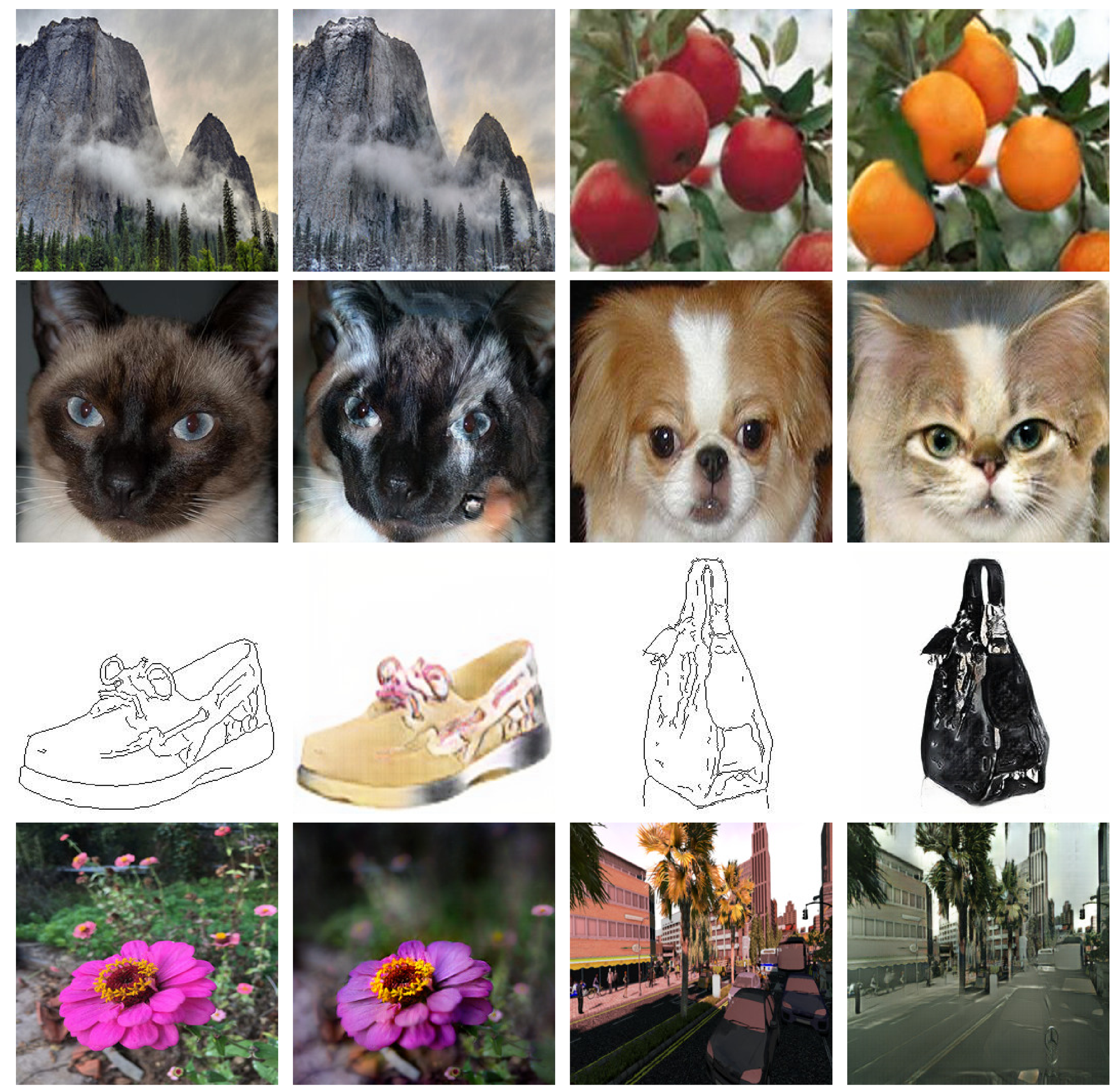
Figure 3: Visualization (left) and 3DMM estimation accuracy results (right) of domain adaptation from rendered faces to real faces.

Visual Comparisons



(a) Input (b) CycleGAN (c) UNIT (d) Ours

More Results



Please **attend** to `https://arxiv.org/abs/1806.06195` for extended version!