KI DELTA LEARNING
Scalable AI for Automated Driving

USIS: Unsupervised Semantic Image Synthesis

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Introduction

Synthetic Image Synthesis can be used to generate photorealistic data for autonomous driving algorithms. SIS allows multimodal mapping and user control over generation process, which can be exploited for model validation in domain gaps or novel classes.

Motivation:

SIS needs large amounts of paired data. There is still a big gap between paired and unpaired methods. How to perform SIS in an unpaired setting? And how to bypass domain gap between labels and images if the 2 datasets come from different distributions (synthetic labels to real images)?

Contribution

- We present two frameworks: (1) USIS for same-domain unpaired training, and (2) Synthetic-to-real-USIS for cross-domain training.

Method

- One-sided cycle loss (layouts to images to layouts).
- Wavelet-based discrimination.
- Discriminator regularization trough self-supervision loss
- New wavelet-based generator architecture.
- We extend USIS for cross-domain training, by discriminating the image and each of ist patches.
- Moreover, we use the synthetic image as aguide to the content of the generated image. Alignment is preserved though a *patch* LPIPS loss.

Results

Figure 3: Results of our model on Cityscapes dataset.

Method	Supervised	Cityscapes FID↓	Cityscapes mIoU↑	ADE20K FID↓	ADE20K mIoU↑	COCO-stuff FID↓	COCO-stuff mIoU↑
CycleGAN[8]	✗	87.2	24.5	96.3	5.4	104.7	2.08
MUNIT[9]	✗	84	8.2	n/a	n/a	n/a	n/a
DRIT[10]	✗	164	9.5	132.2	0.016	135.5	0.008
DistanceGAN[12]	✗	78	17.6	80	0.035	92.4	0.014
GCGAN[11]	✗	80	8.4	92	0.07	99.8	0.019
CUT[1]	✗	57.3	29.8	79.1	6.9	85.6	2.21
USIS	✗	**53.7**	**44.8**	**33.2**	**17.38**	**27.8**	**14.06**
CRN[31]	✓	104.7	52.4	73.3	22.4	70.4	23.7
SIMS[78]	✓	49.7	47.2	n/a	n/a	n/a	n/a
Pix2pixHD[3]	✓	95.0	58.3	81.8	20.3	111.5	14.6
SPADE[4]	✓	71.8	62.3	33.9	38.5	22.6	37.4
CC-FPSE[35]	✓	54.3	65.5	31.7	43.7	19.2	41.6
OASIS[2]	✓	47.7	69.3	28.3	48.8	17.0	44.1

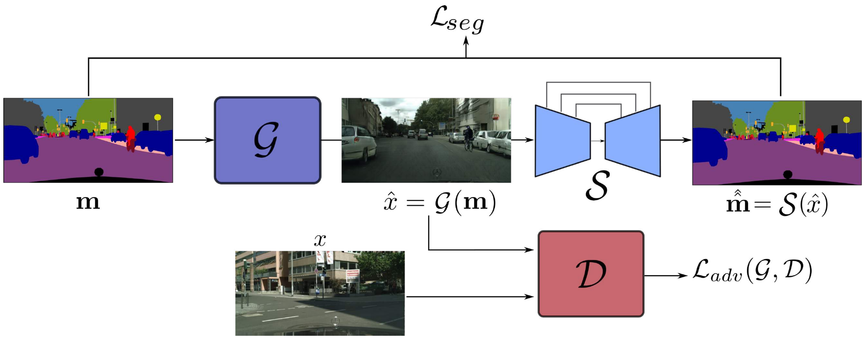

Figure 1: Architecture of the proposed USIS Framework

Knowledge Transfer

Partners

External partners

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