Model-based disentanglement of lens occlusions

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1 *Inria*
INVENTEURS DU MONDE NUMÉRIQUE

2 VISLAB.it
Extend Your Vision

Clear weather

I2I GAN

Rainy

Unrealistic results

Target domain encompasses occlusions (raindrops)

Problem: this is impractical to supervise !
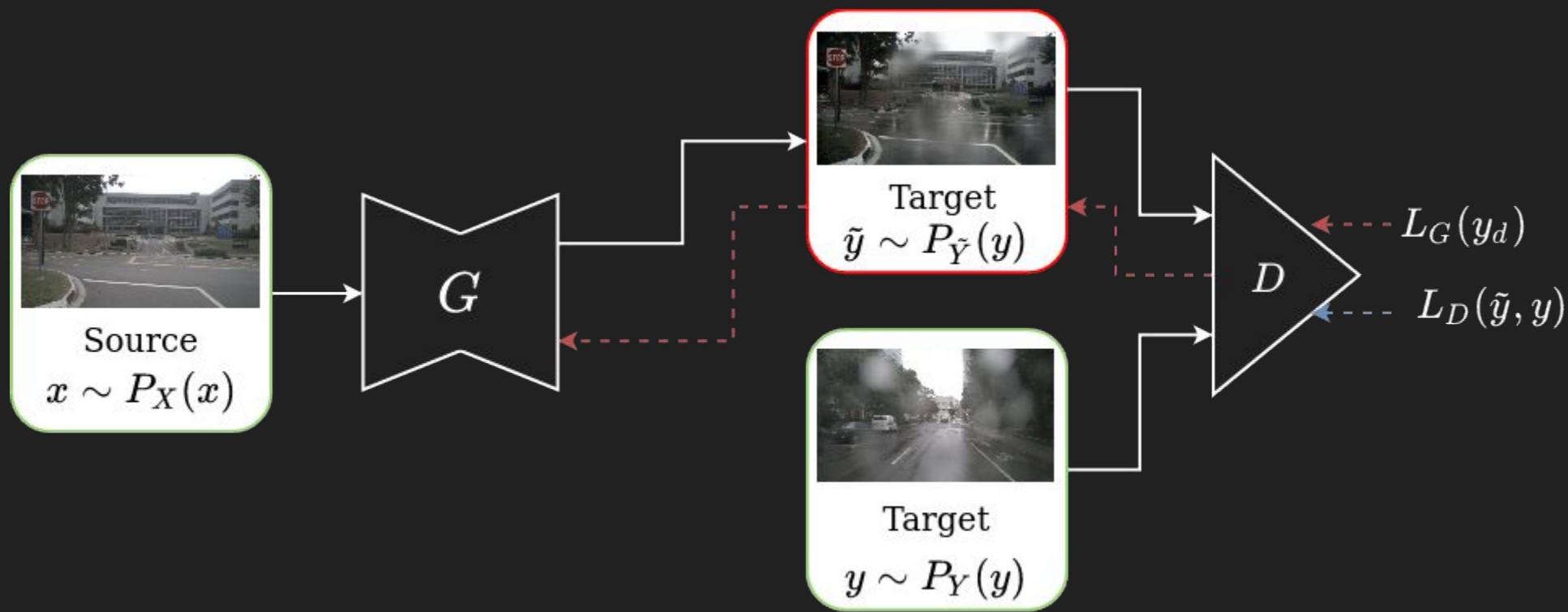
Out-of-focus parameters
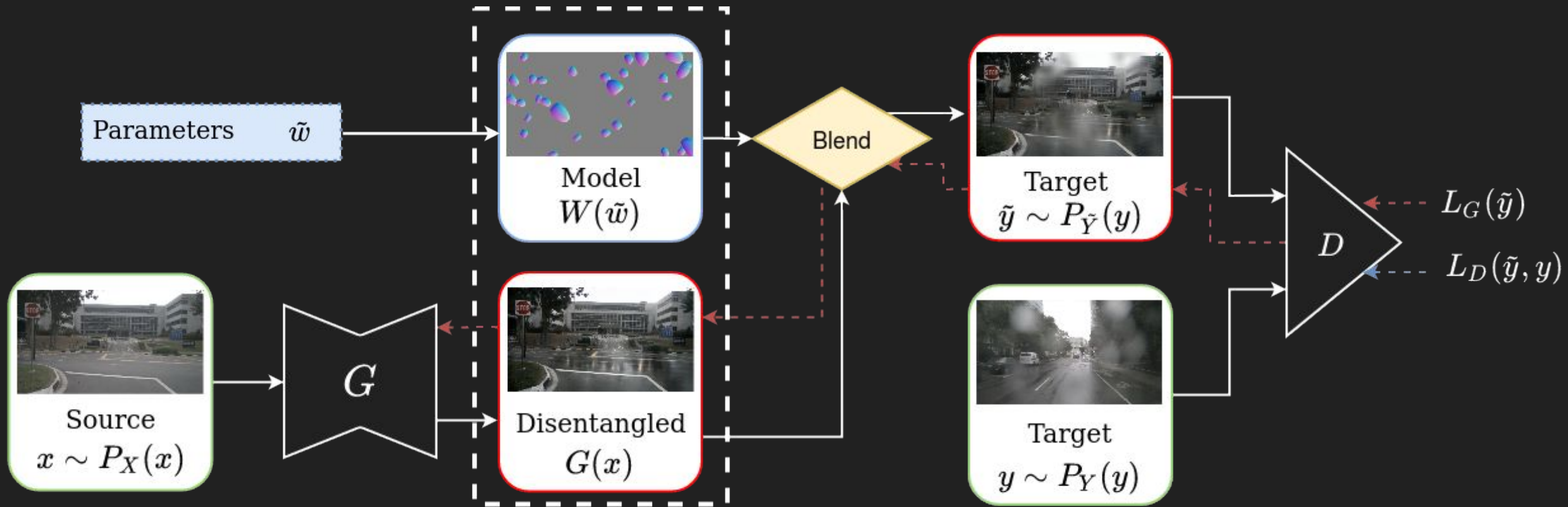
In-focus parameters

Clear weather

Target + occlusions

$$\forall x \in X, x \sim P_X(x) \qquad \forall y \in Y, y \sim P_Y(y)$$
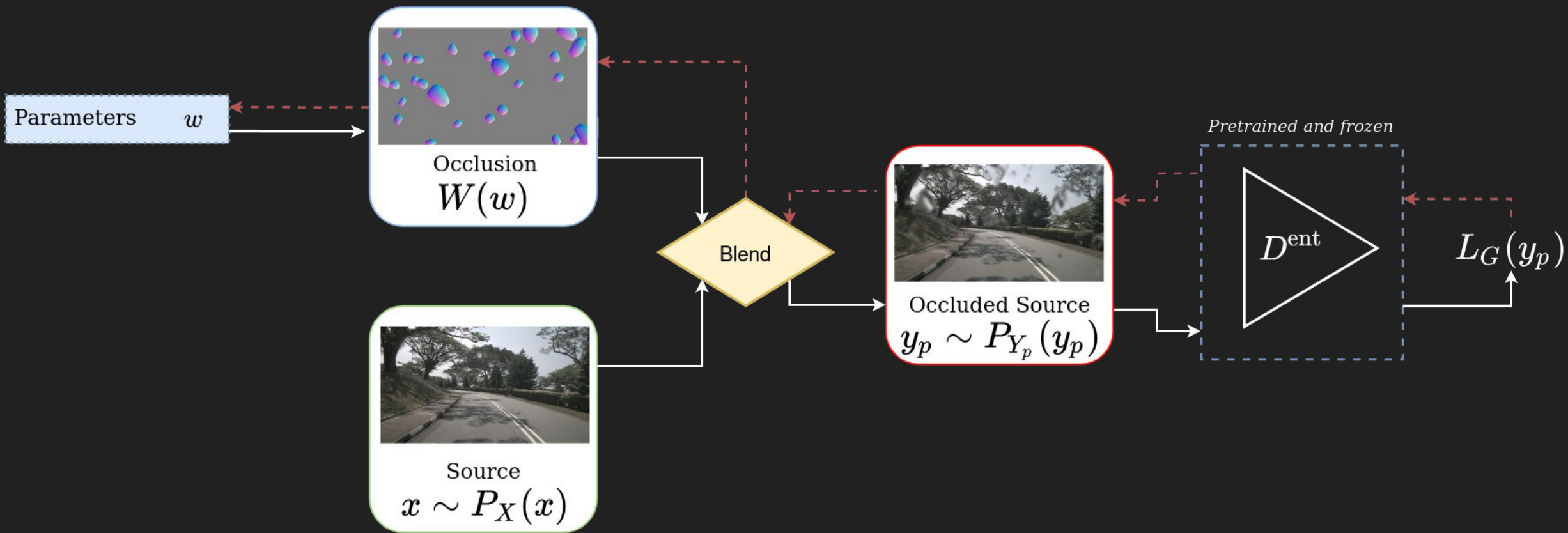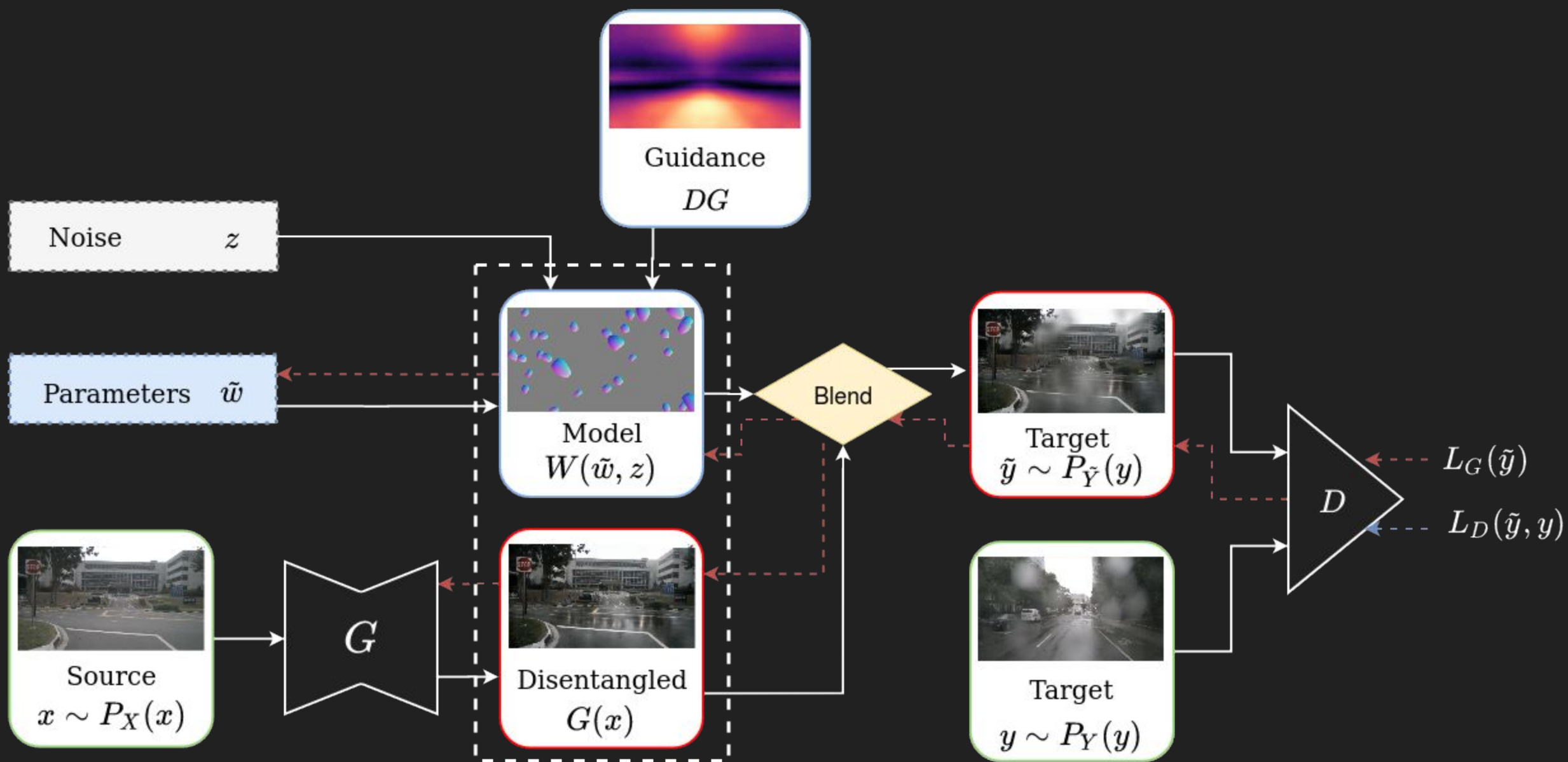
Unsupervised representation disentanglement

$$P_Y(y) = \underbrace{P_{Y_S, Y_O}(y_S, y_O)}_{\text{Scene + occlusions}} = \underbrace{P_{Y_S}(y_S)}_{\text{Scene}} \underbrace{P_{Y_O}(y_O)}_{\text{Occlusions}}$$

Parameters w

Occlusion
$W(w)$

Source
$x \sim P_X(x)$

Blend

Occluded Source
$y_p \sim P_{Y_p}(y_p)$

Pretrained and frozen

D^{ent}

$L_G(y_p)$

8

Displacement maps
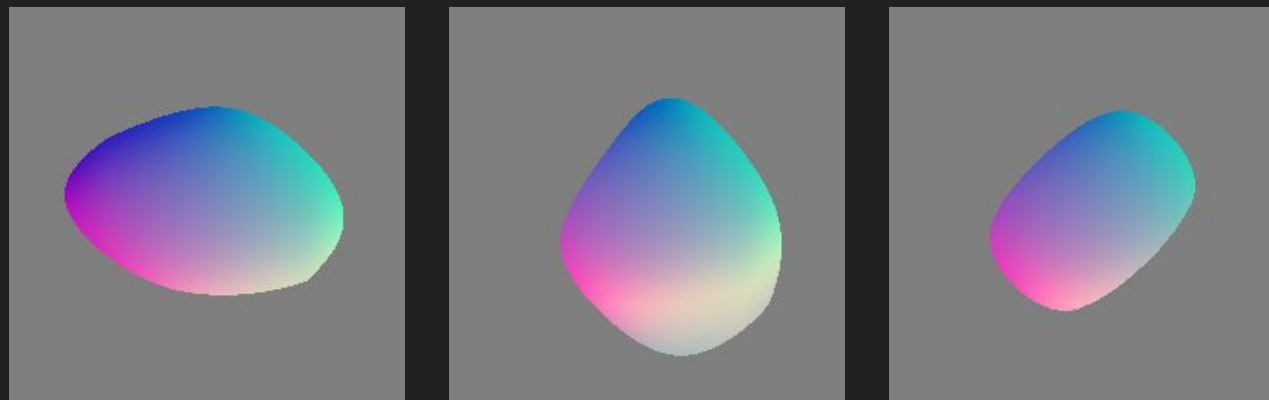
Defocus blur effects

σ = 1   σ = 3.5   σ = 19

Original

Target

MUNIT [1]

Ours

Disentangled

$\tilde{w}$

Dashcam - 1

Dashcam - 2

[1] X Huang et al., ECCV 2018

	Method	IS	LPIPS	CIS
Unimodal	CycleGAN [2]	1.151	0.473	-
	AttentionGAN [3]	1.406	0.464	-
	U-GAT-IT [4]	1.038	0.489	-
Multimodal	DRIT [5]	1.189	0.492	1.120
	MUNIT [1]	1.211	0.495	1.030
	Ours - Target	**1.532**	**0.515**	**1.148**

[1] X Huang et al., ECCV 2018
[2] JY Zhu et al., ICCV 2017
[3] H Tang et al., IJCNN 2019
[4] J Kim et al., ICLR 2020
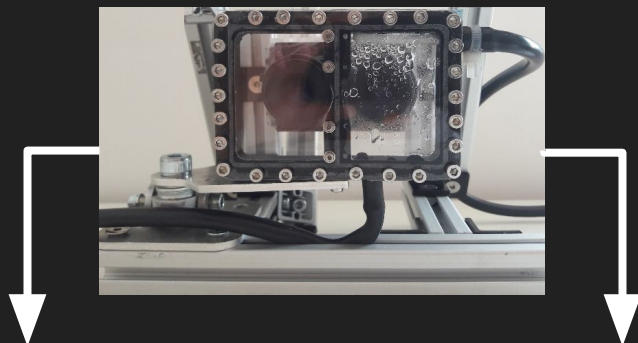[5] HY Lee et al., IJCV 2019

WoodScape [47]   **Synthia [33]** (synthetic)

Target

Source

Clean image   Real raindrops   Porav et al. [6]   **Ours**

Thanks for your attention!

Questions?

Using disentanglement to improve semantics

Method	AP↑
Original (from [11])	18.7
Finetuned w/ Halder *et al.* [11]	25.6
Finetuned w/ Ours target	**27.7**

[11] Halder et al., ICCV 2019

Ablation study - drops model complexity

Model	IS↑	LPIPS↑	CIS↑
MUNIT (baseline) [1]	1.211	0.495	1.030
Ours - Normal	1.351	0.513	1.125
Ours - Refraction	1.459	0.496	1.123
Ours	**1.532**	**0.515**	**1.148**

[1] X Huang et al., ECCV 2018

Validity of our physical parameter estimation

Method	FID↓	LPIPS↓
Porav et al. [28]	207.34	0.533
Ours target	**135.32**	**0.438**

[28] H Porav et al., ICRA 2019
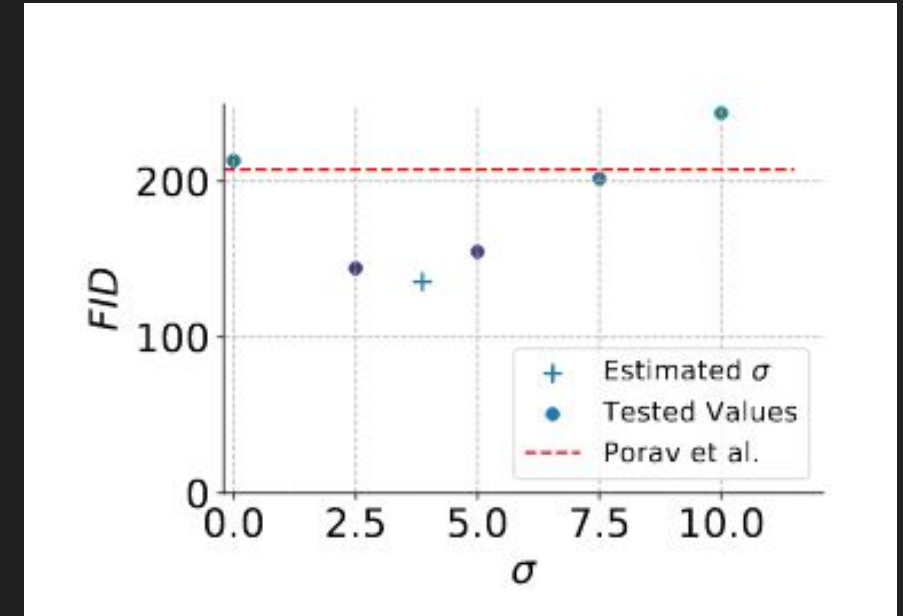
Ablation study - disentanglement guidance

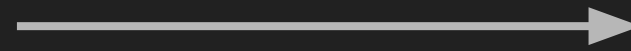(a) Source   (b) $\beta = 0$ (i.e. baseline)   (c) $\beta = 0.75$ (ours)   (d) $\beta = 1$

No guidance   ⟶   Strict guidance