

5D Light Field Synthesis from a Monocular Video

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Light Field Camera

LYTRO



∞ raytrix



* Lytro has officially shut down in 2018.

Goal



Main contributions:

1. First end-to-end deep learning-based framework for **5D light field video synthesis**
2. A **new photorealistic synthetic dataset** for light field video synthesis network training
3. Capability of **synthesizing light field video for real scenes** while the network is **trained on the synthetic dataset**

Light Field Datasets

- Stanford Light Field Archive
- MIT Synthetic Light Field Archive
- HCI Light Field datasets
- MPI Light Field Archives
- ...

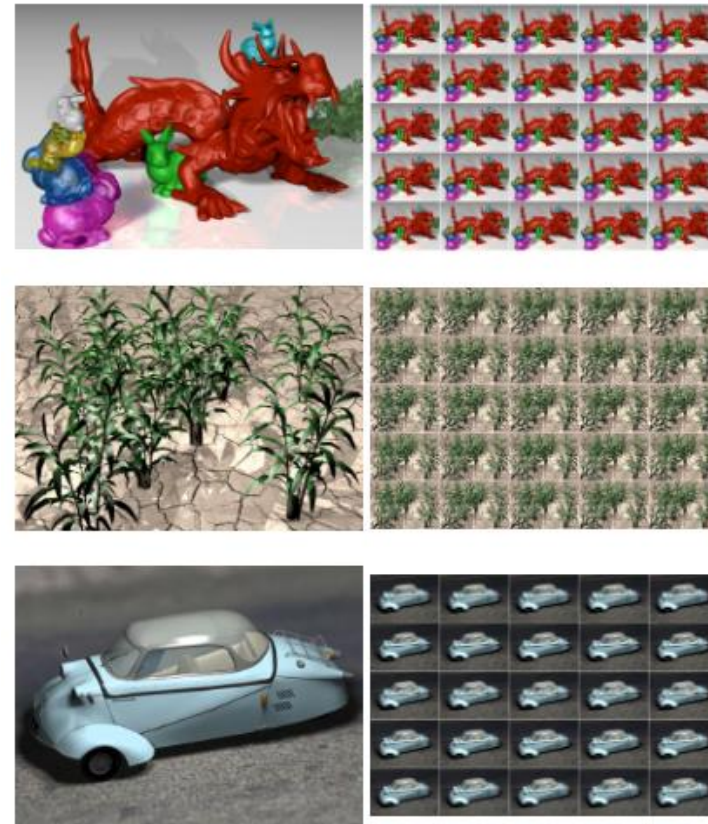


Image from: <https://web.media.mit.edu/~gordonw/SyntheticLightFields/>

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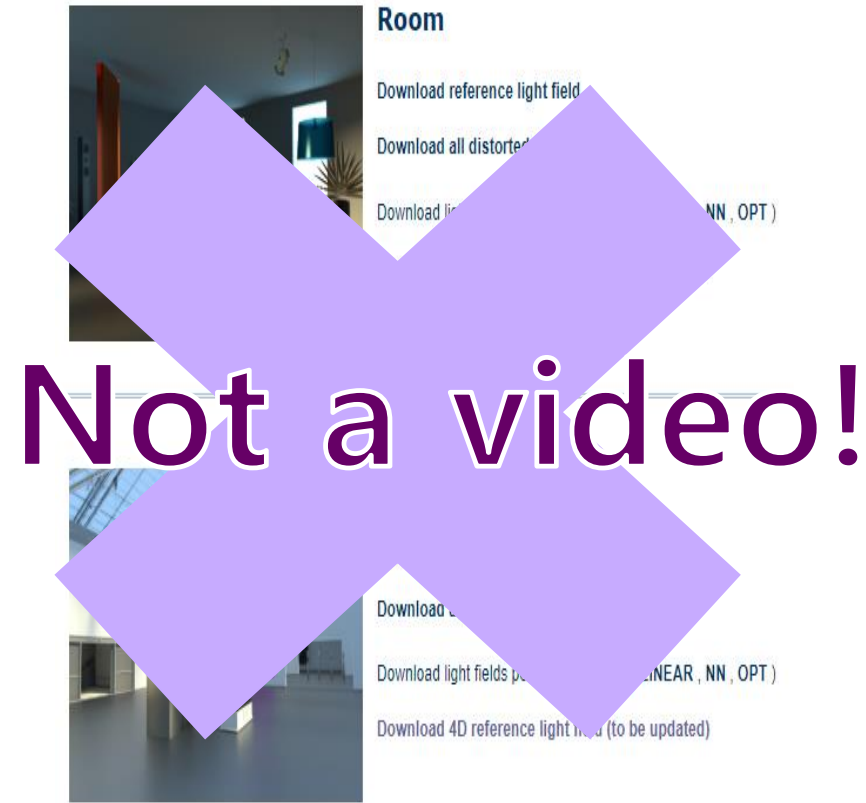


Image from: <http://lightfields.mpi-inf.mpg.de/Dataset.html>

Proposed Method

■ Synthetic dataset

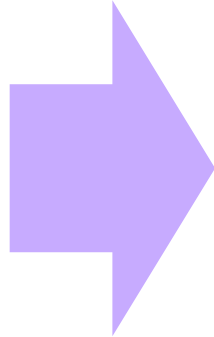


UNREAL
ENGINE

Virtual environment

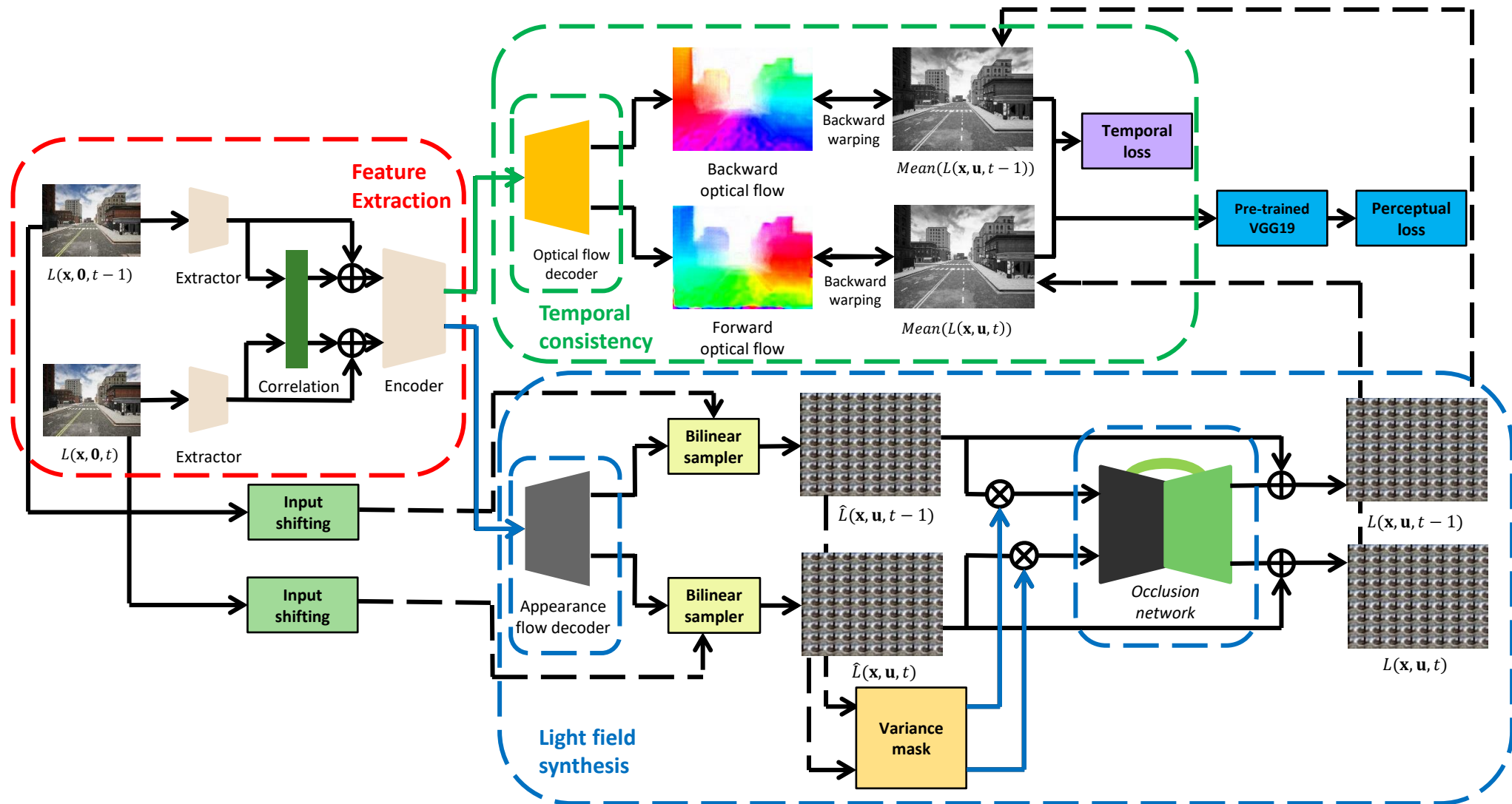


Virtual light field camera
(9 x 9)



W. Qiu and A. Yuille, "UnrealCV: Connecting computer vision to unreal engine," ECCV 2016.

Proposed Method



Appearance Flow

Image



$$L_s(\mathbf{x}, 0, t)$$

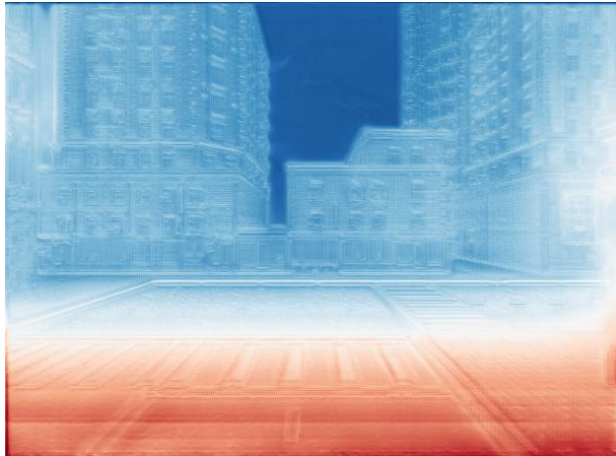


$$L_s(\mathbf{x}, 8, t)$$

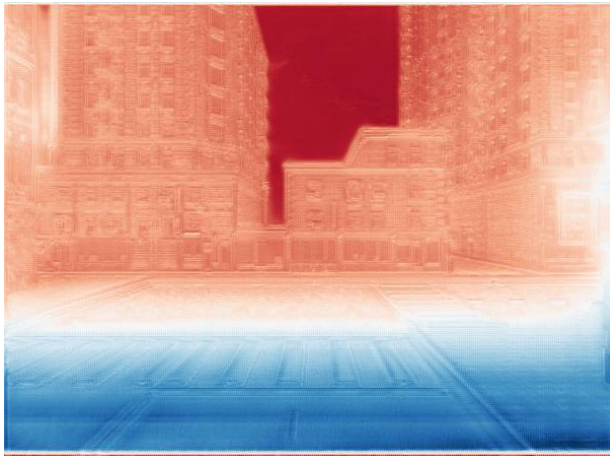


$$L_s(\mathbf{x}, 0, t)$$

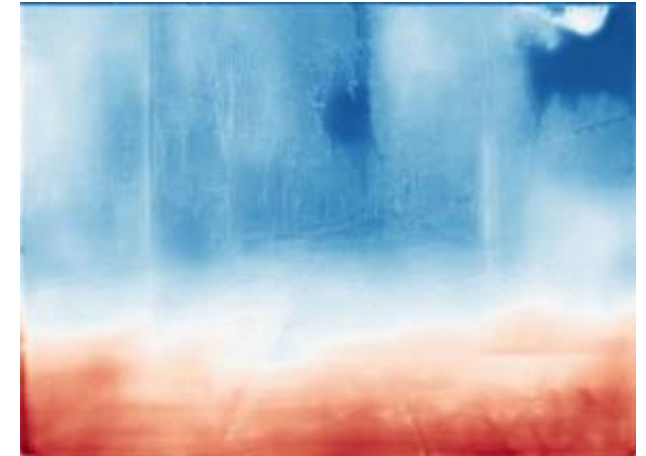
Appearance
flow



$$L_f(\mathbf{x}, 0, t)$$



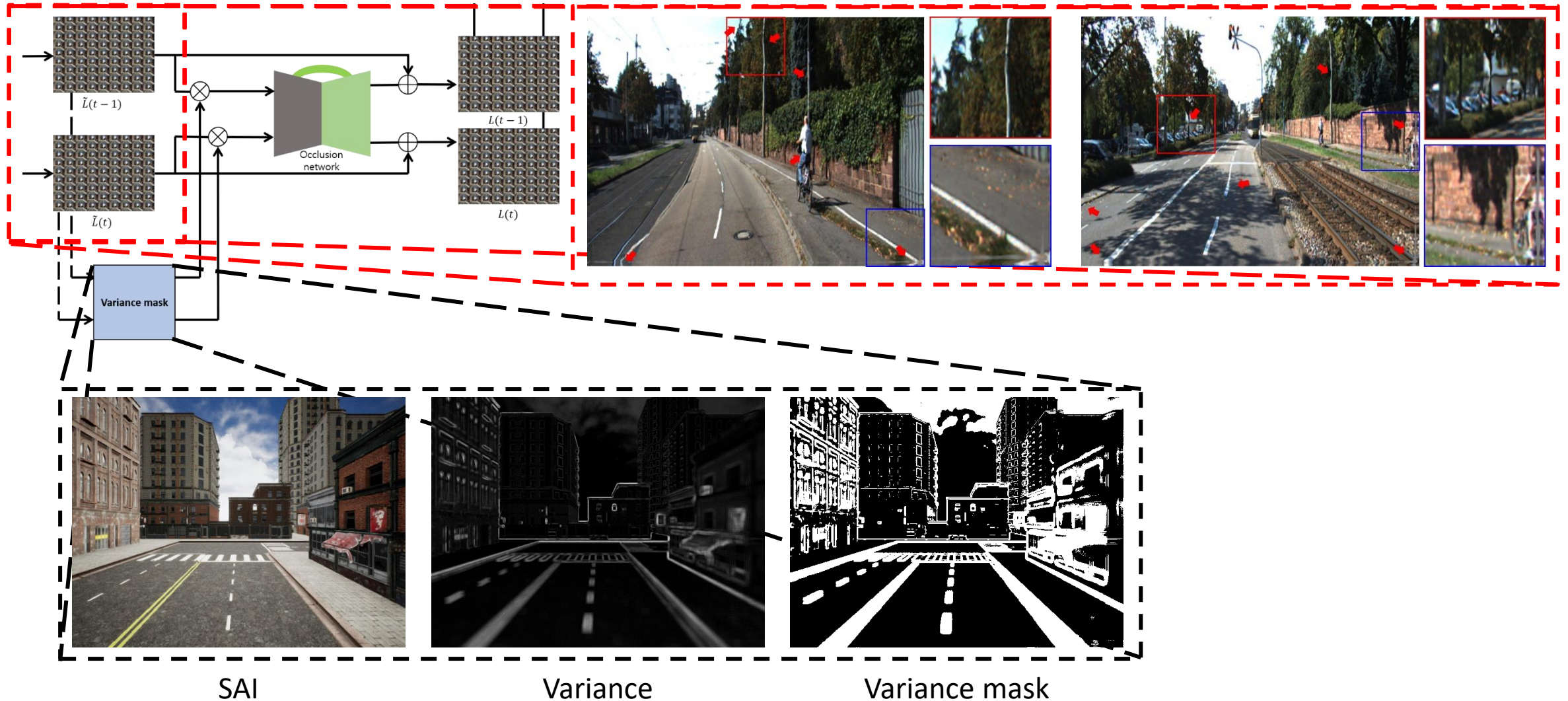
$$L_f(\mathbf{x}, 8, t)$$



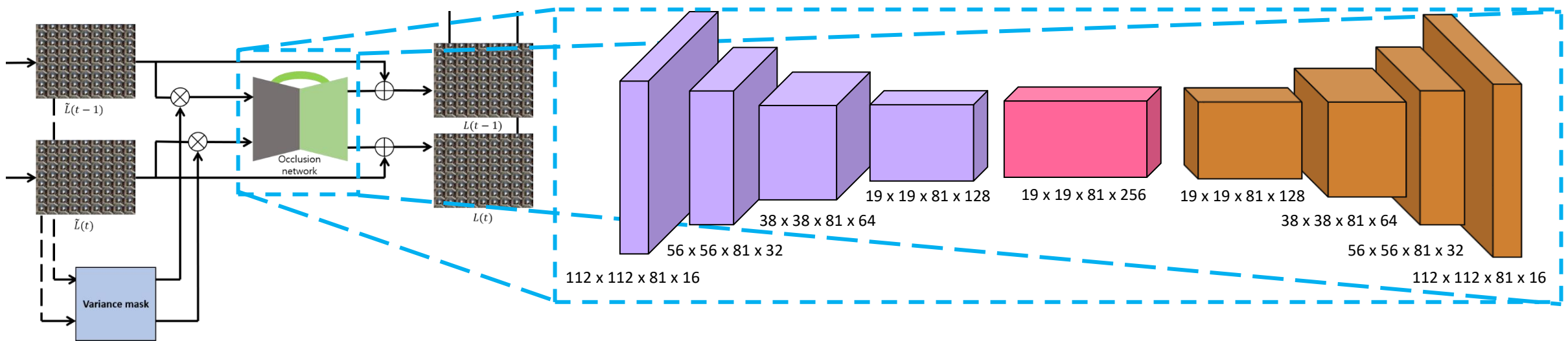
$$L_f(\mathbf{x}, 0, t)$$



Occlusion Network



Occlusion Network



Without Occlusion network



With Occlusion network

Qualitative Evaluation

Srinivasan *et al.* [2017]



Ivan *et al.* [2019]



Proposed



Qualitative Evaluation

Srinivasan *et al.* [2017]



Ivan *et al.* [2019]



Proposed



Qualitative Evaluation

Srinivasan *et al.* [2017]



Ivan *et al.* [2019]



Proposed



The model is trained with synthetic dataset (driving scene)

Data from: Wang et al., "Light Field Video Capture Using a Learning-Based Hybrid Imaging System."

Quantitative Evaluation



Synthetic #1



Synthetic #2

Dataset	Synthetic #1		Synthetic #2	
Metric	PSNR	SSIM	PSNR	SSIM
Srinivasan <i>et al.</i>	22.56	0.696	24.99	0.735
Ivan <i>et al.</i>	23.52	0.708	26.76	0.804
Proposed	23.77	0.732	27.11	0.831

Conclusion

- We proposed the method for **synthesizing 5D light field video using synthetic dataset**
- We also showed that the network trained using synthetic light field dataset **can be extended effectively for the real scene**
- Future work includes the **generalization** of the proposed method **for more variety of real scene**

