

# CVPR 2020 最佳论文解读

## **Unsupervised Learning of Probably Symmetric Deformable 3D Objects from Images in the Wild**

Shangzhe Wu      Christian Rupprecht      Andrea Vedaldi

Visual Geometry Group, University of Oxford

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黄高

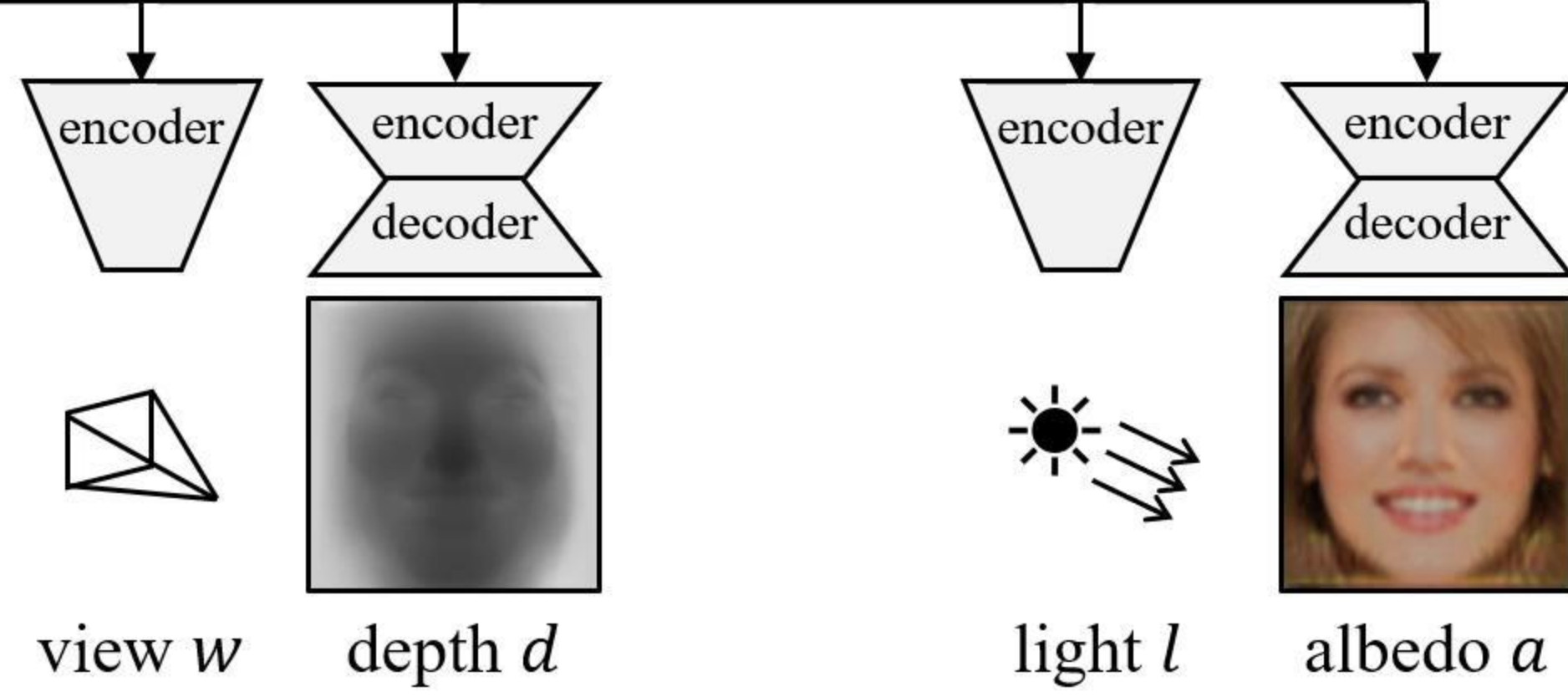
自动化系 助理教授

2020-06-28



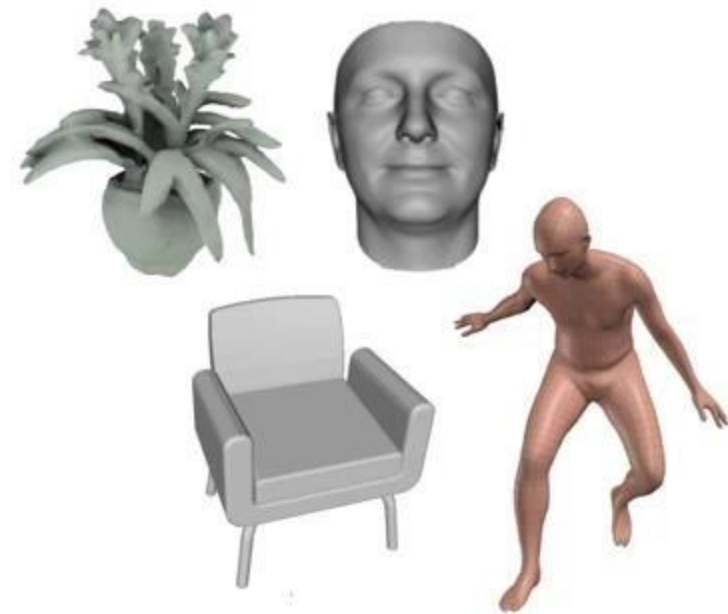


input  $I$

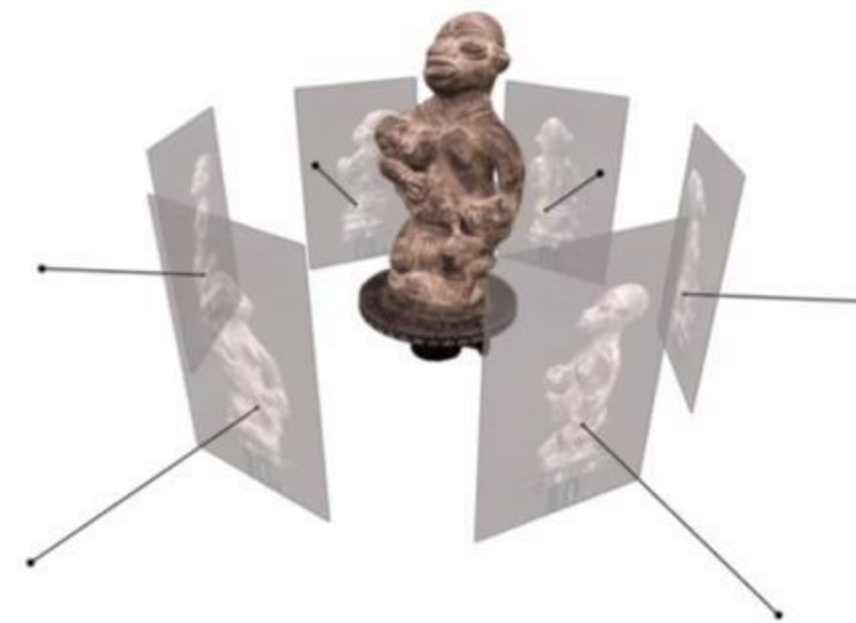




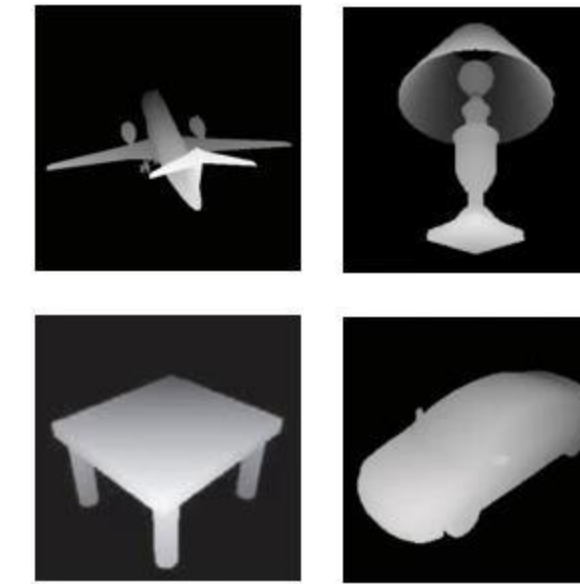
# Supervision for 3D Reconstruction



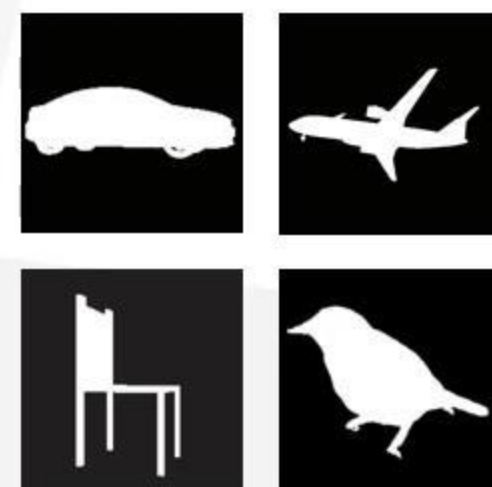
3D ground truth or  
shape models



multi-views



depth maps



silhouettes



keypoints



camera viewpoint



# Unsupervised Learning of 3D Objects

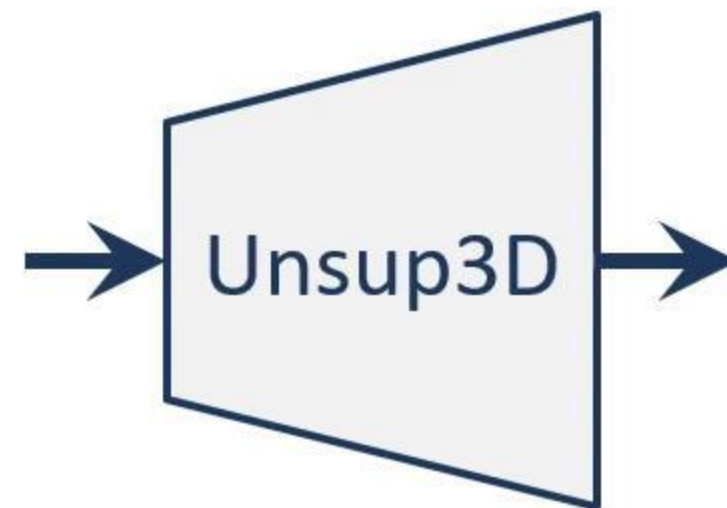


Training Data



single-view images of a category

NO other supervision!



Output



instance-specific 3D shapes



# Unsupervised Learning of 3D Objects

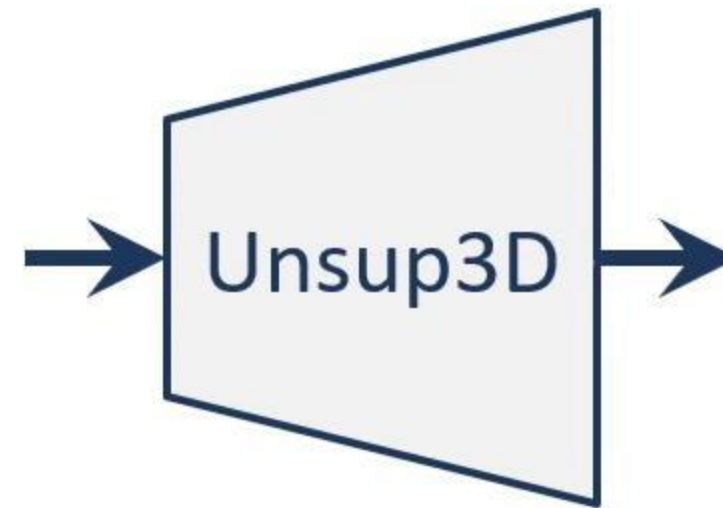


Training Data

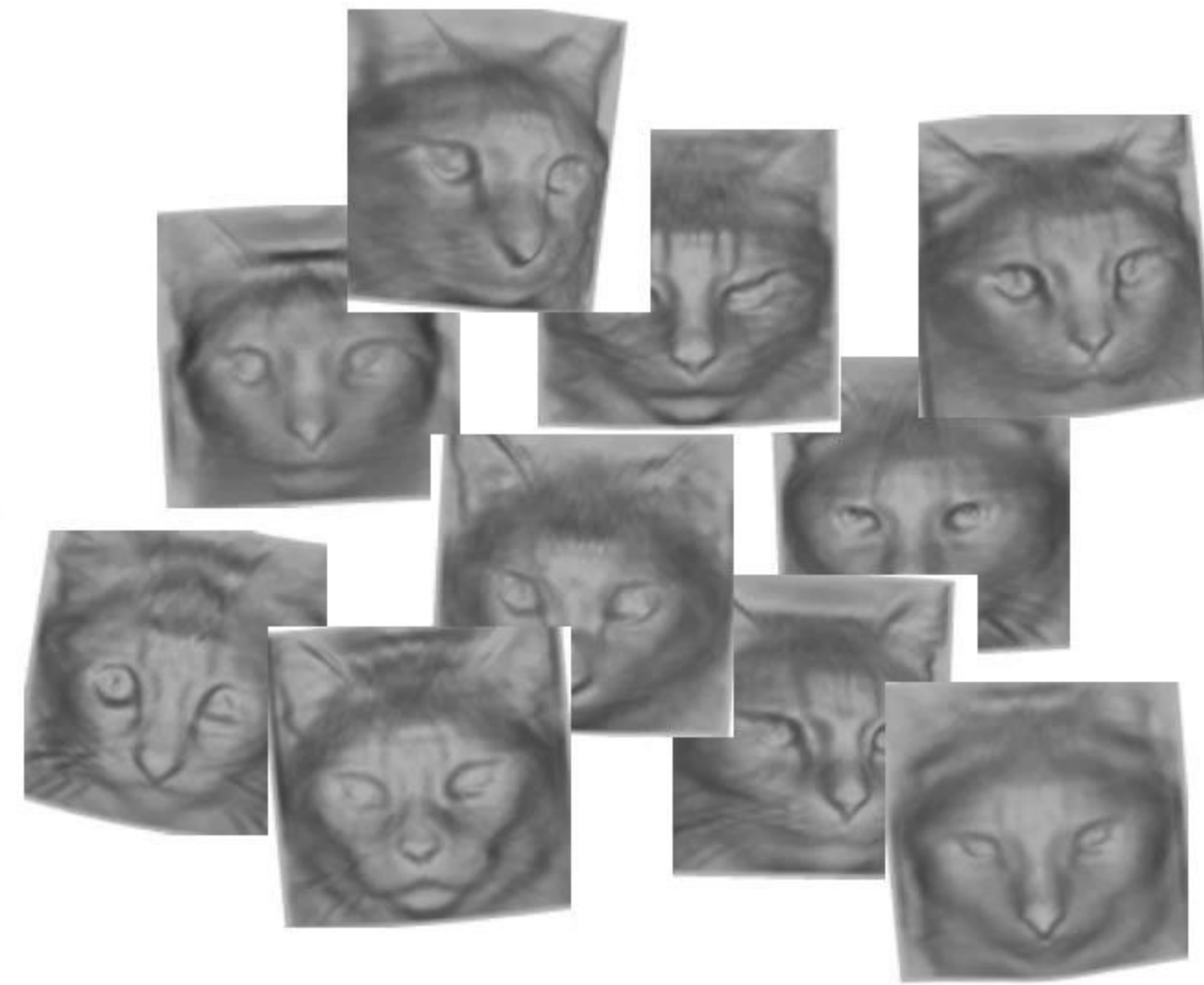


single-view images of a category

NO other supervision!



Output



instance-specific 3D shapes



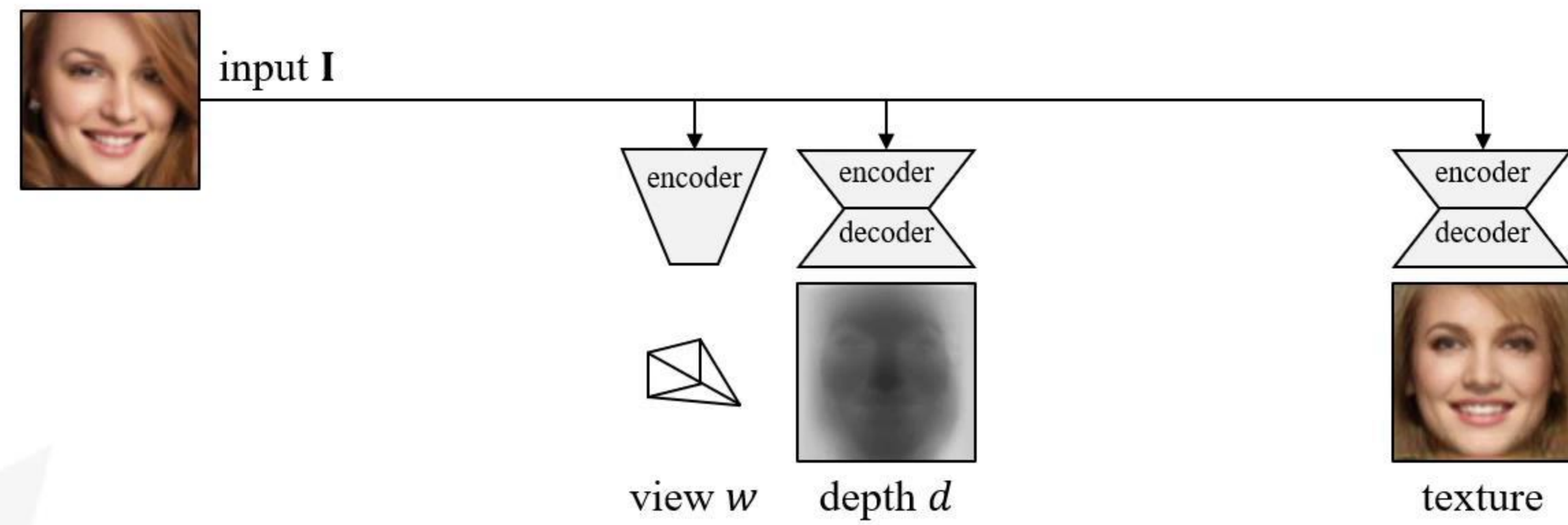


# Training Pipeline: **Photo-Geometric Autoencoding**



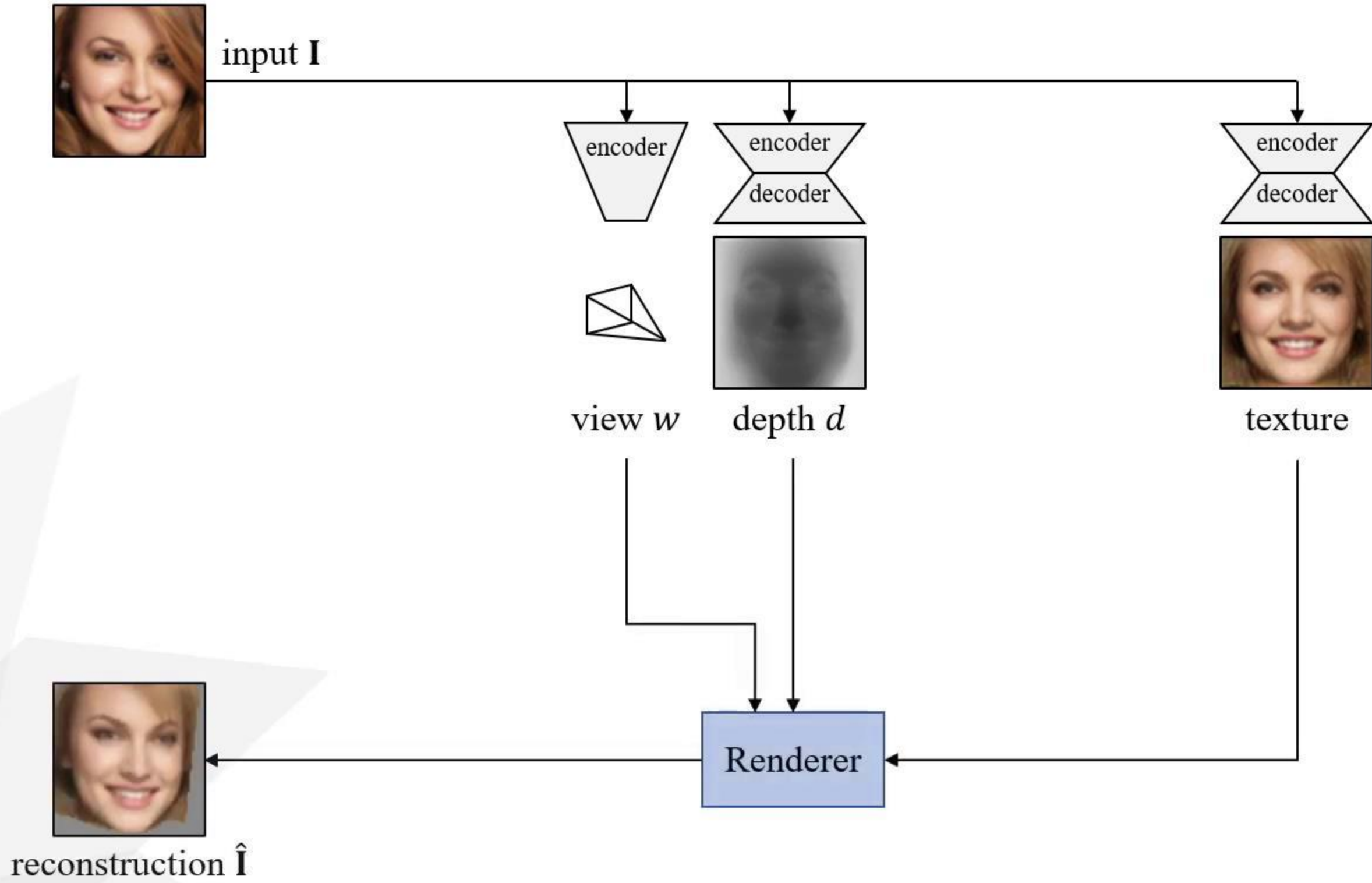


# Photo-Geometric Autoencoding



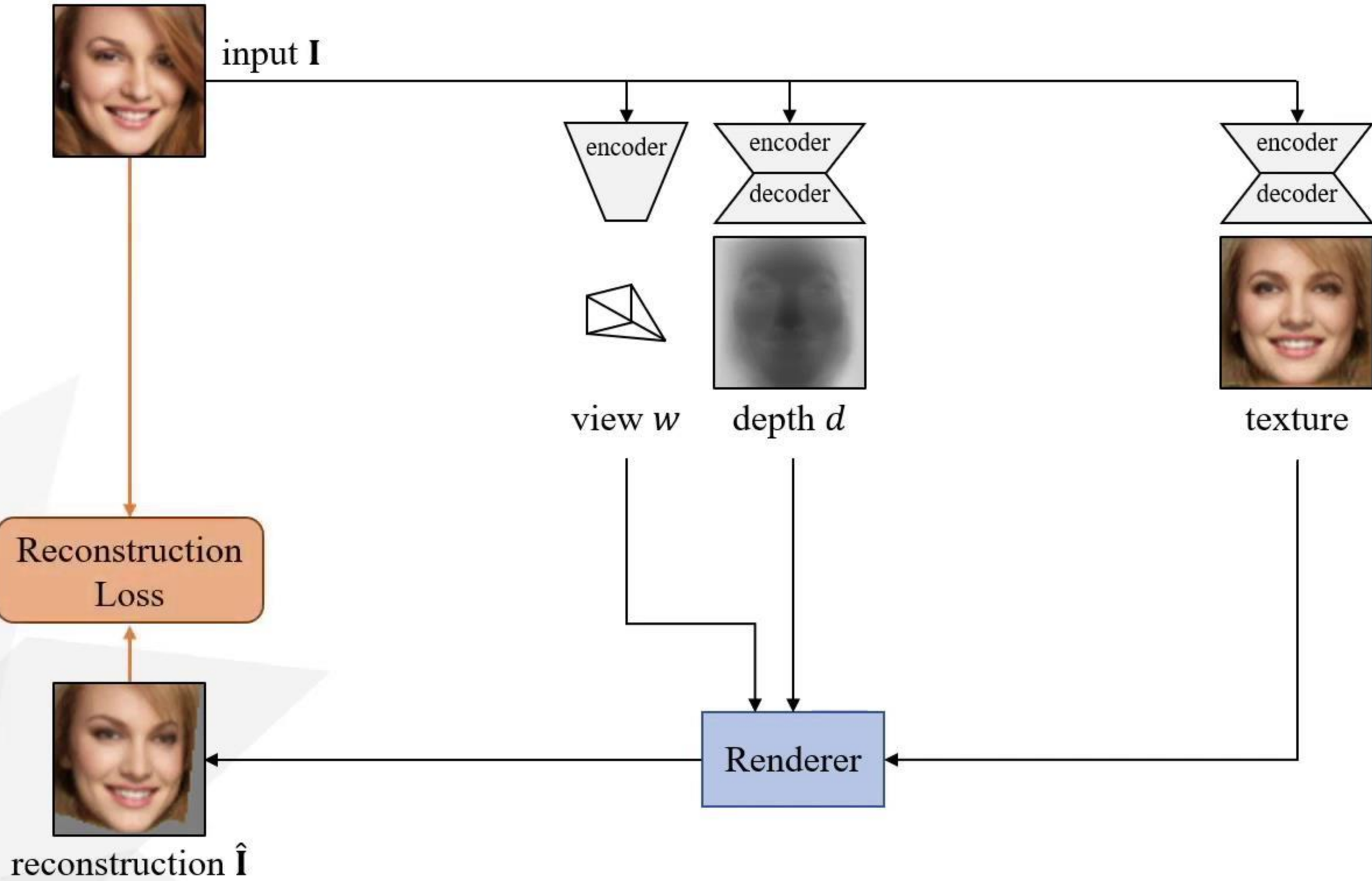


# Photo-Geometric Autoencoding



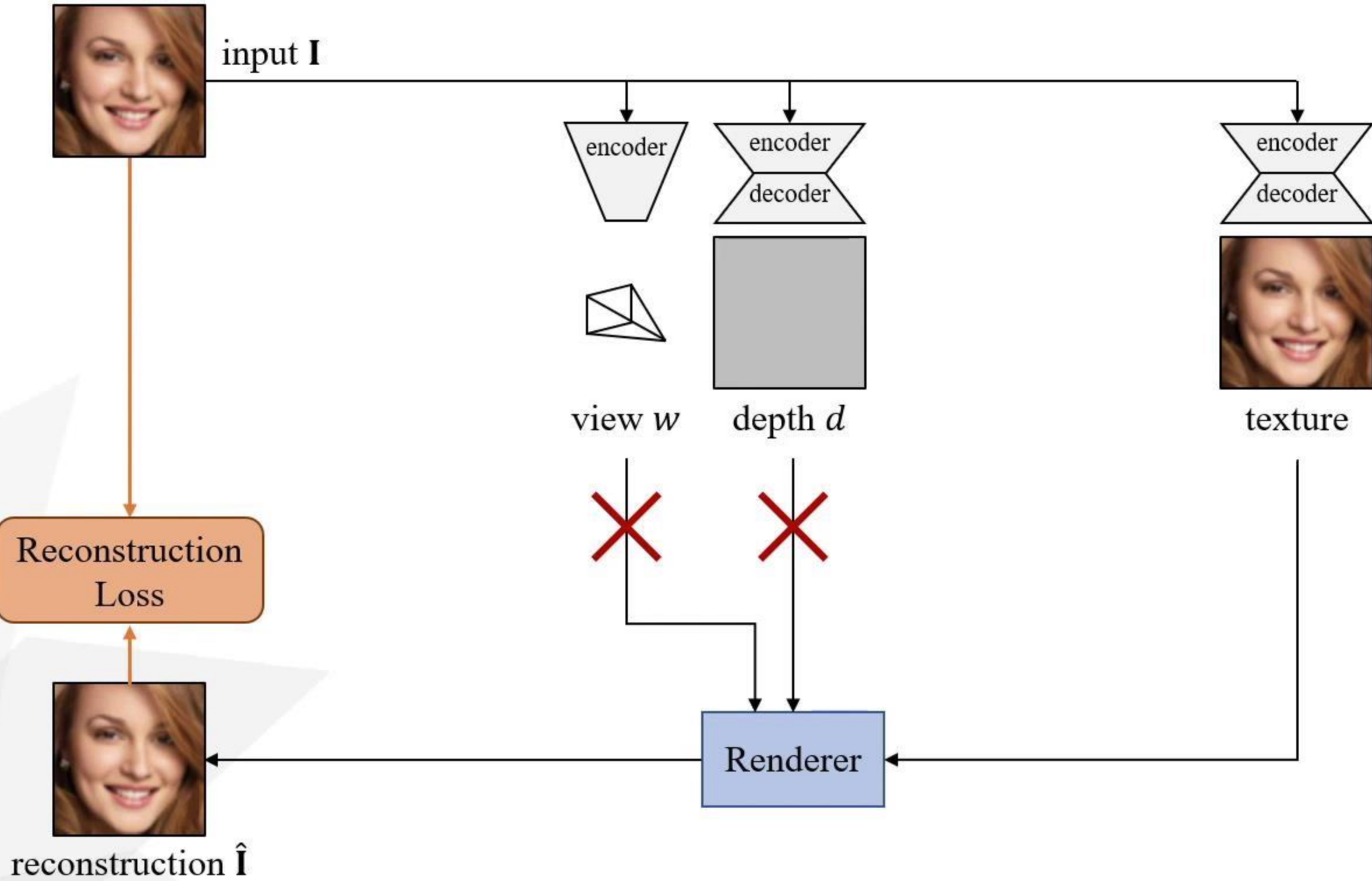


# Photo-Geometric Autoencoding





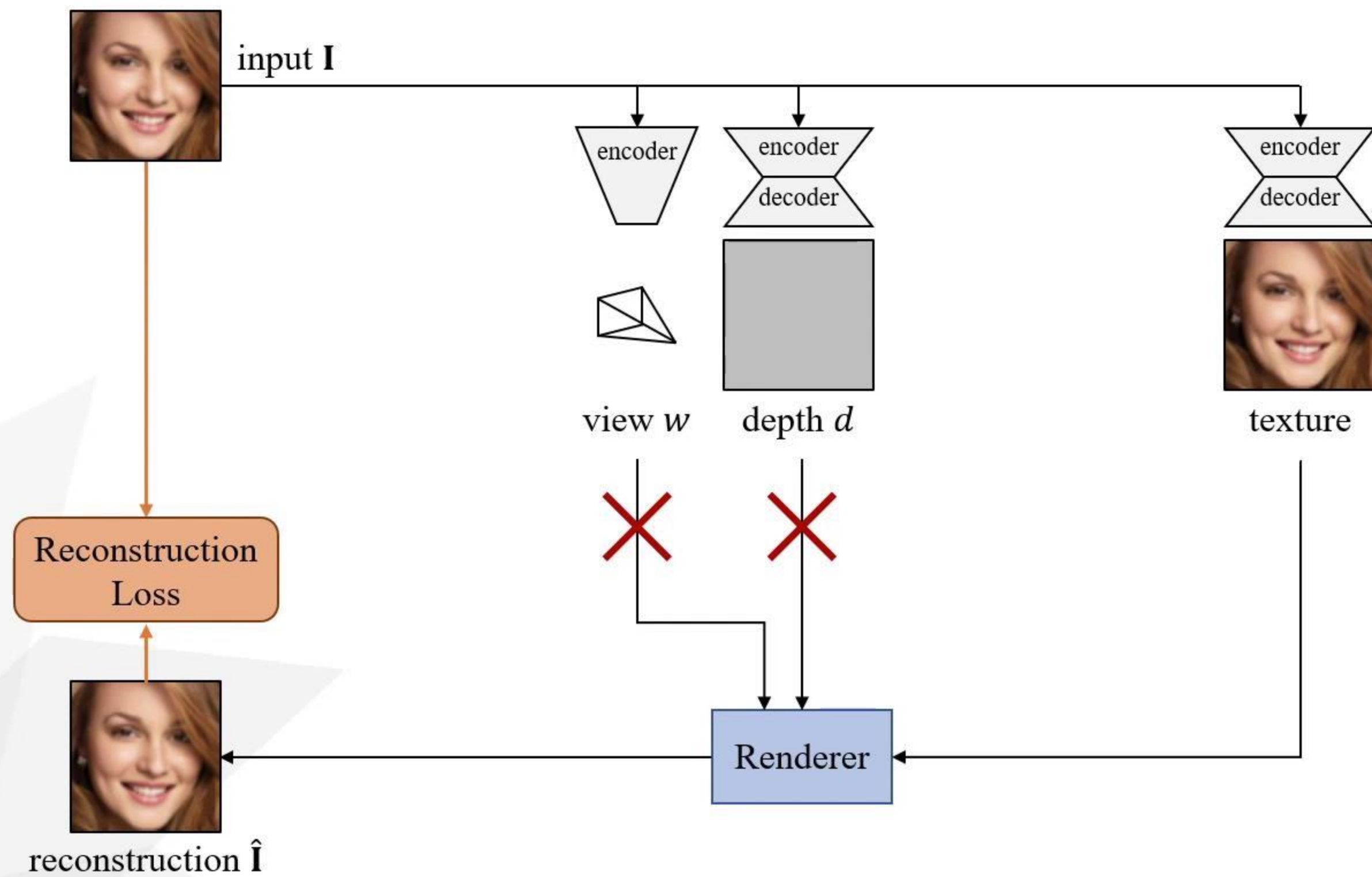
# Photo-Geometric Autoencoding





# Photo-Geometric Autoencoding

Q1: How to avoid degenerate solutions?

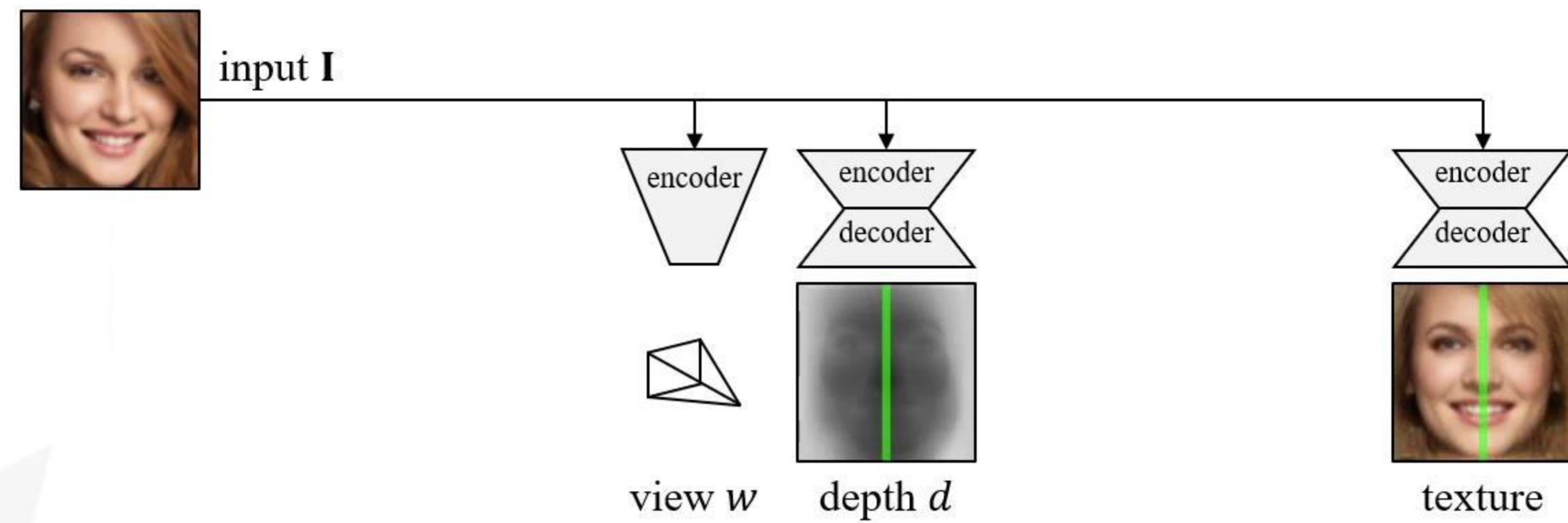




# Photo-Geometric Autoencoding

**Q1:** How to avoid degenerate solutions?

**A1:** Enforce symmetry

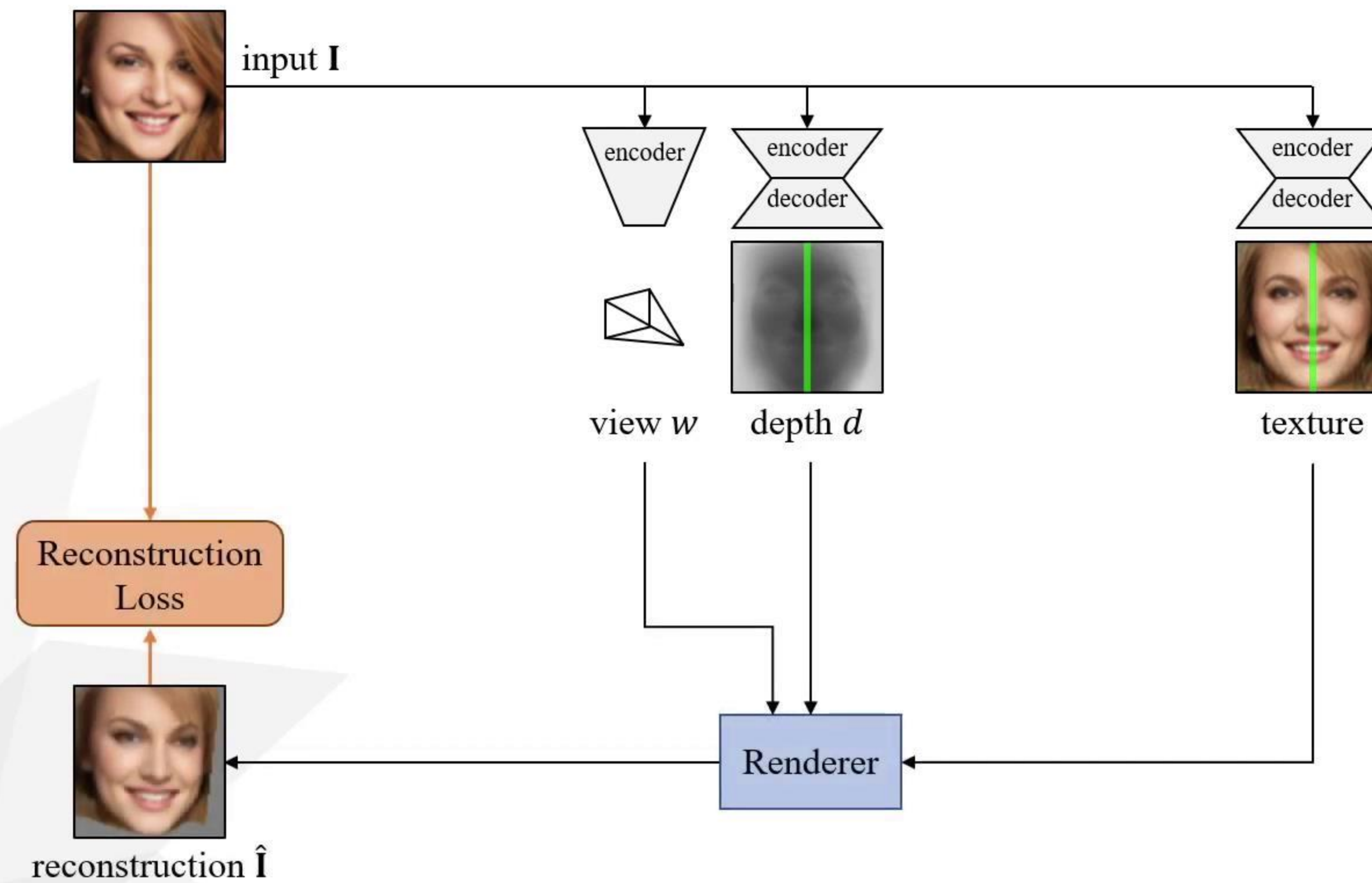




# Photo-Geometric Autoencoding

**Q1:** How to avoid degenerate solutions?

**A1:** Enforce symmetry

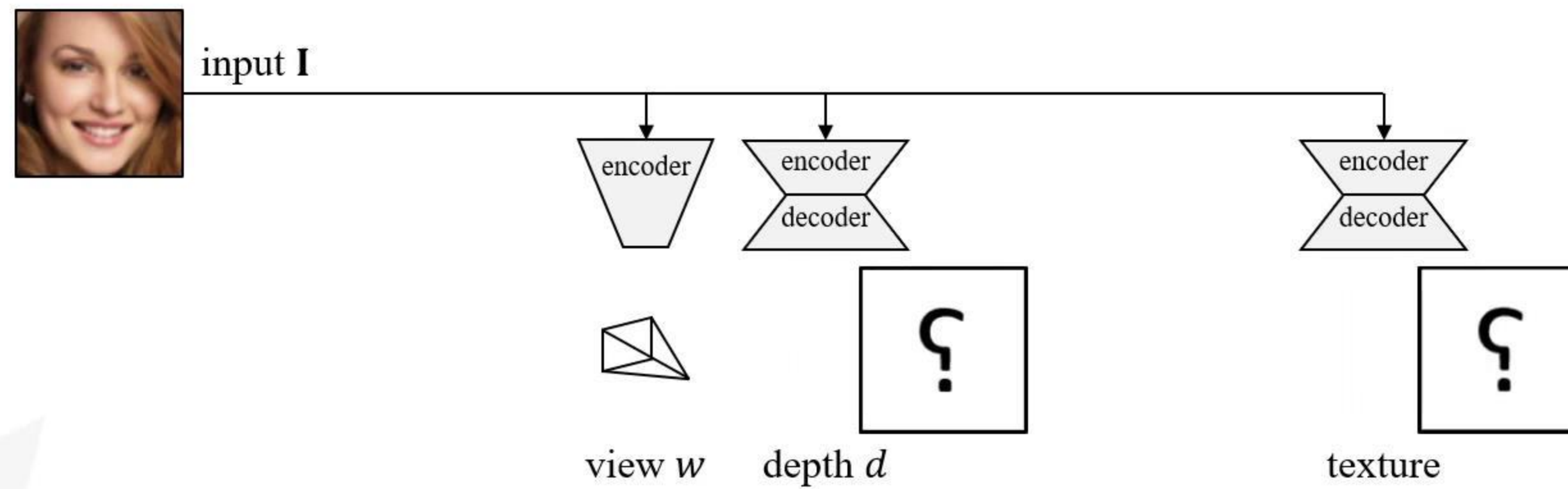




# Photo-Geometric Autoencoding

**Q1:** How to avoid degenerate solutions?

**A1:** Enforce symmetry by flipping

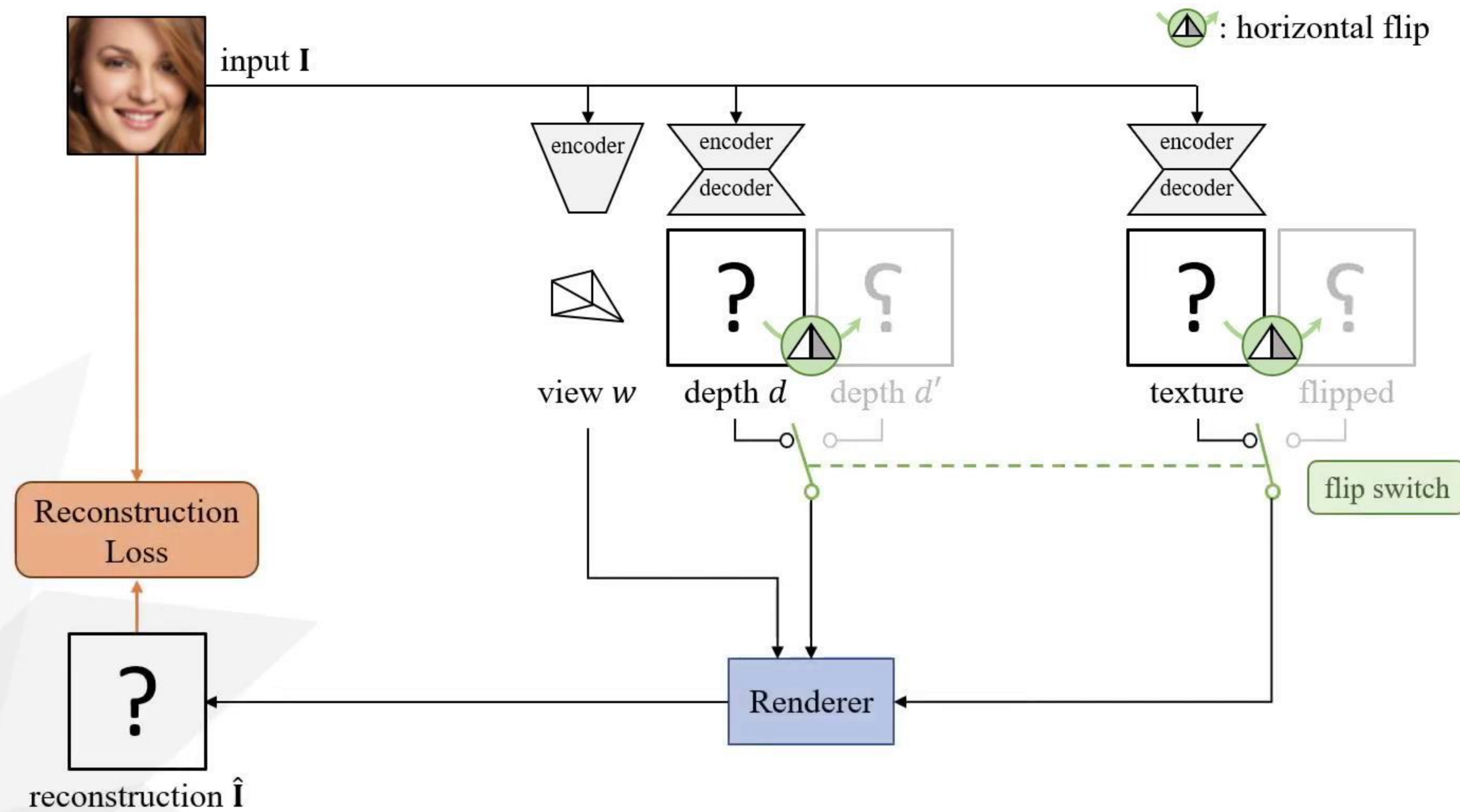




# Photo-Geometric Autoencoding

Q1: How to avoid degenerate solutions?

A1: Enforce symmetry by flipping

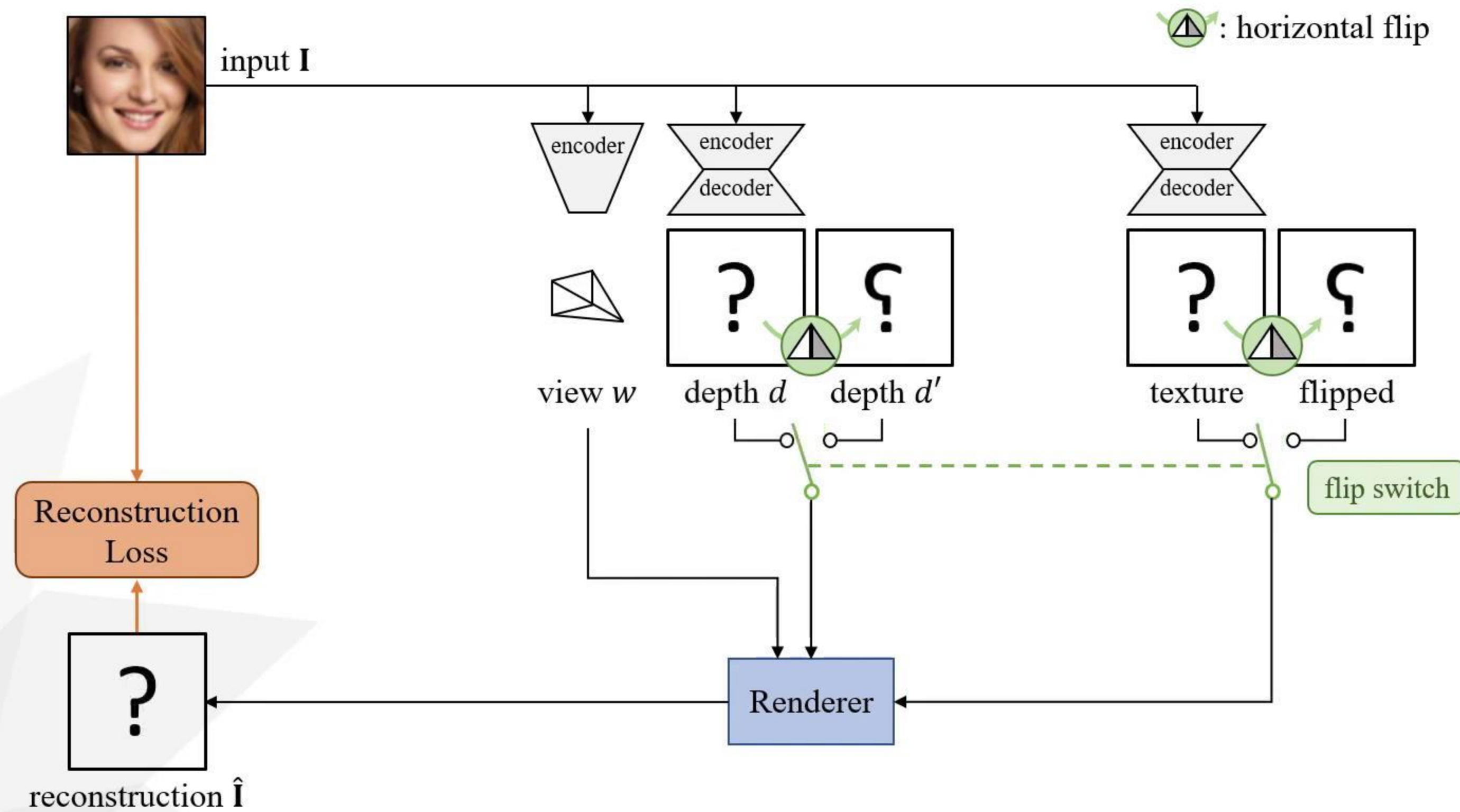




# Photo-Geometric Autoencoding

Q1: How to avoid degenerate solutions?

A1: Enforce symmetry by flipping

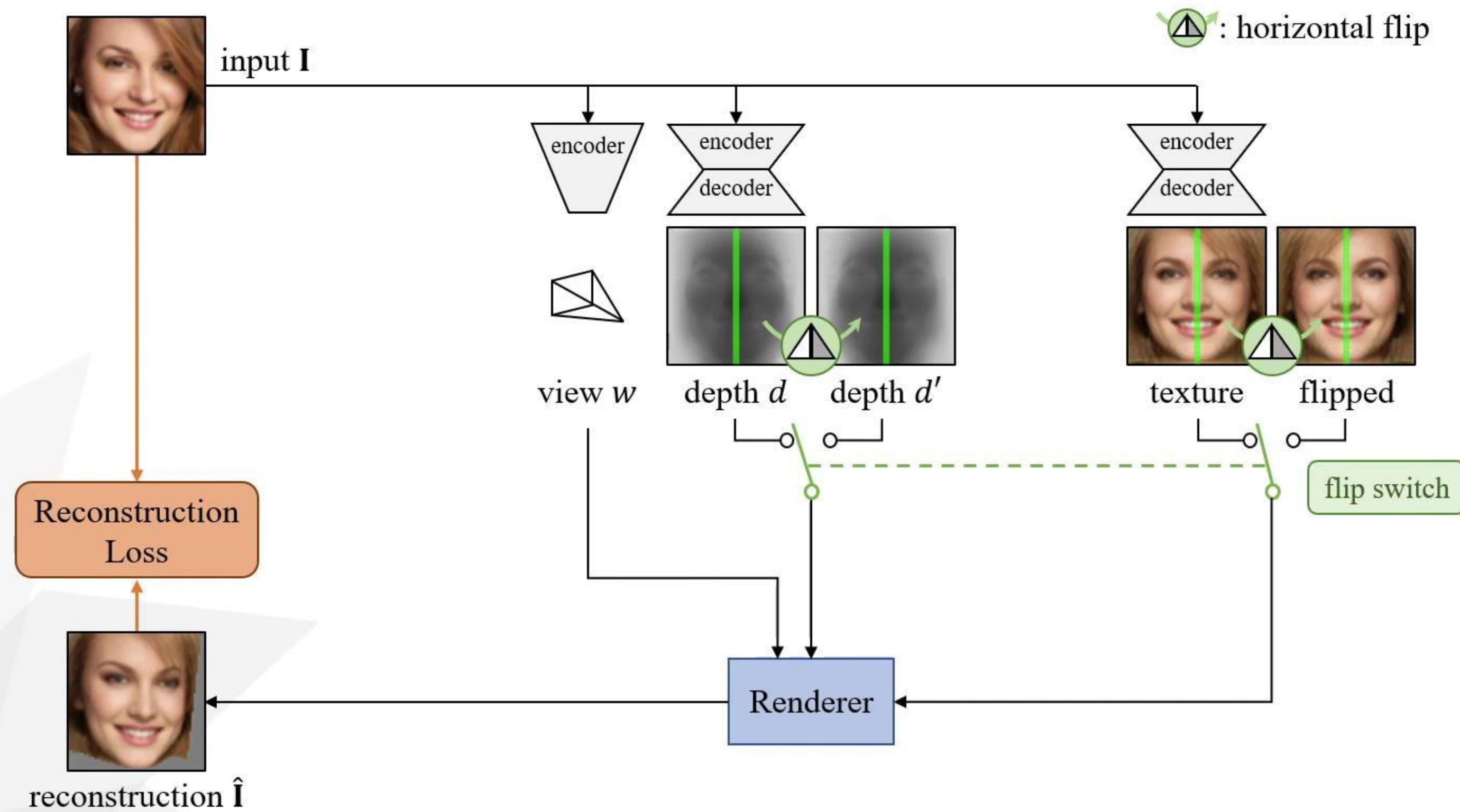




# Photo-Geometric Autoencoding

Q1: How to avoid degenerate solutions?

A1: Enforce symmetry by flipping

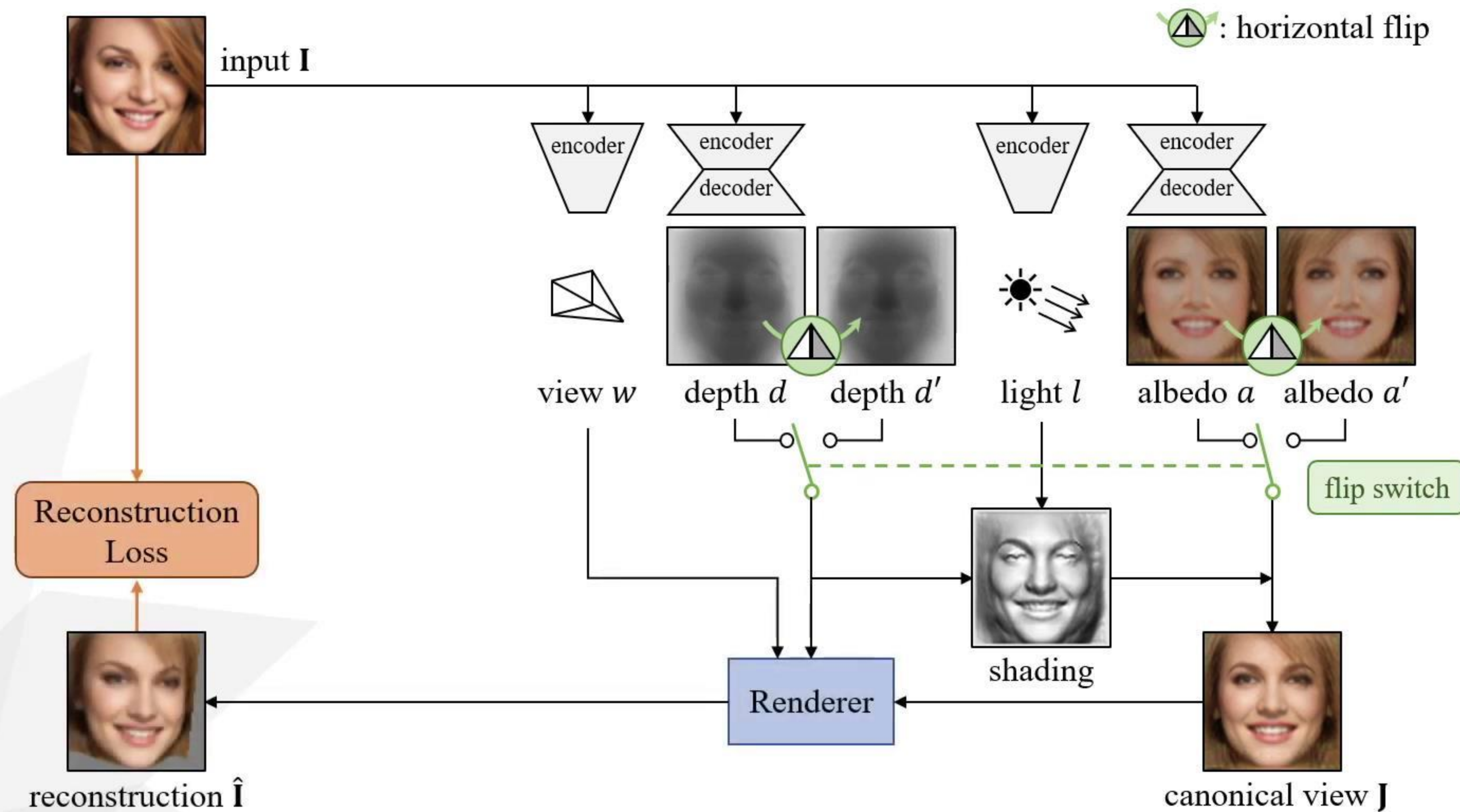




# Photo-Geometric Autoencoding

Q2: What about non-symmetric lighting?

A2: Enforce symmetry on albedo

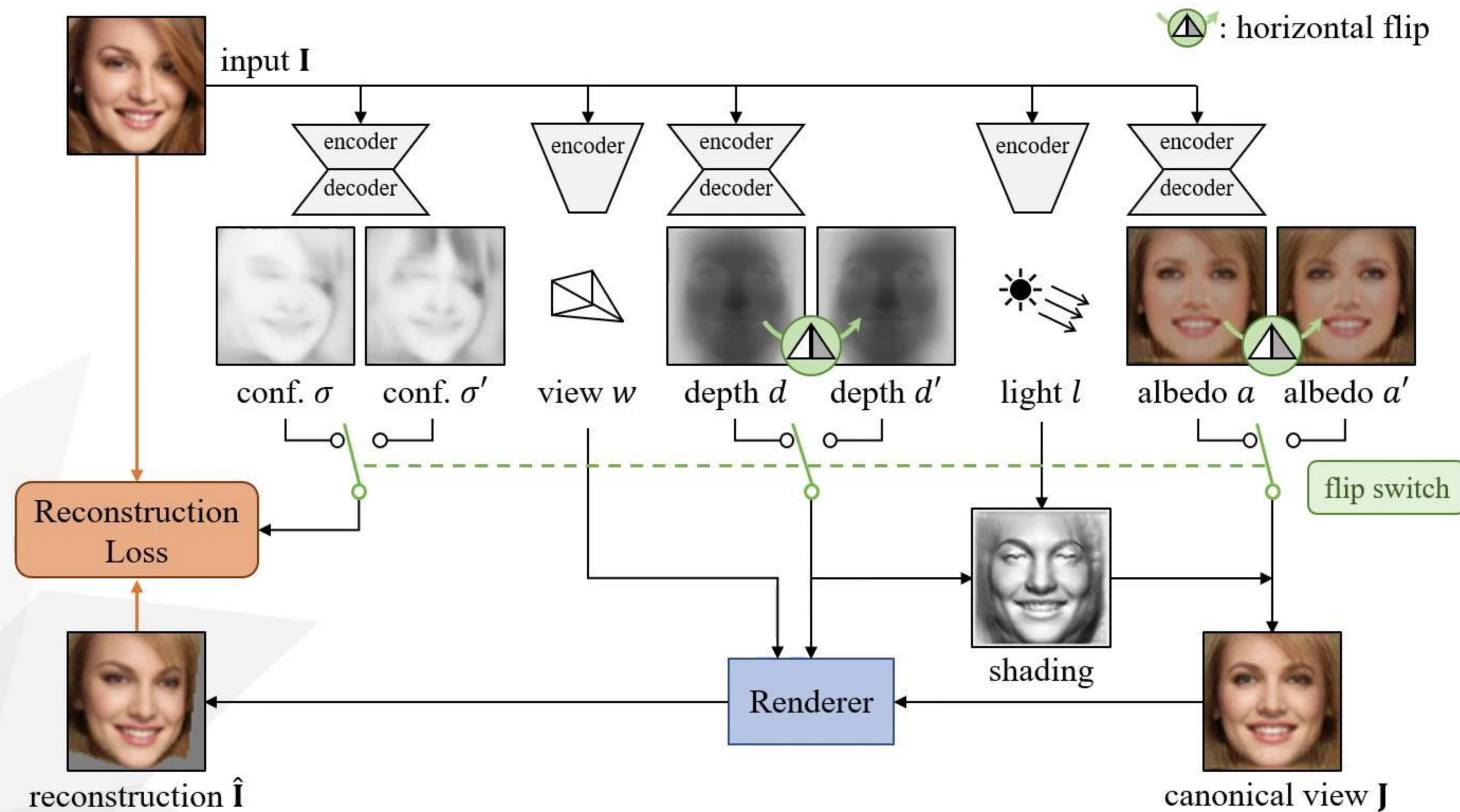




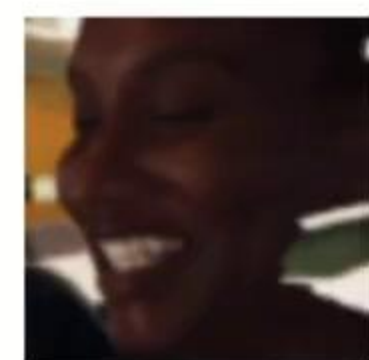
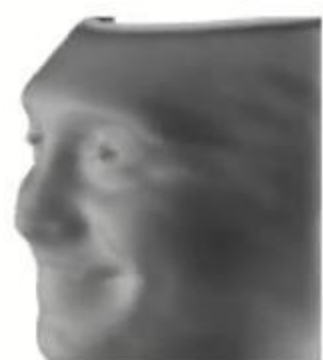
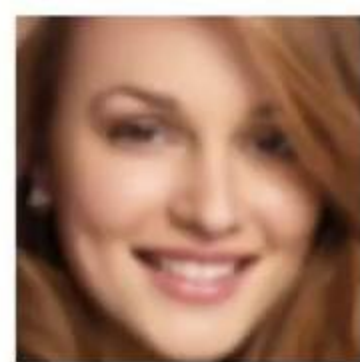
# Photo-Geometric Autoencoding

Q3: Non-symmetric albedo, deformation, etc?

A3: Predict uncertainty







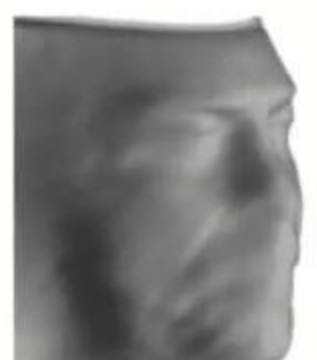
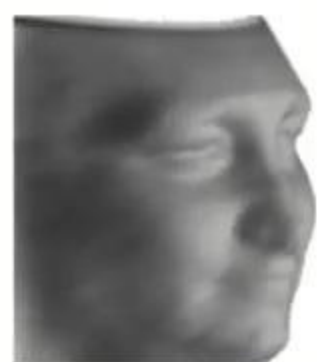
input

reconstruction

input

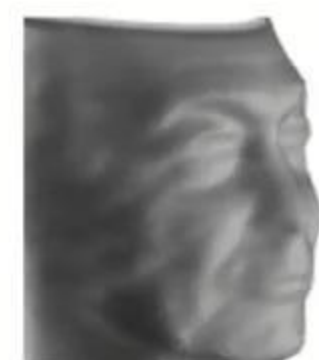
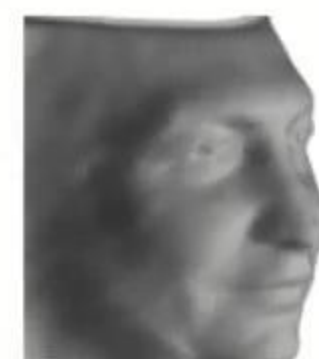
reconstruction





input

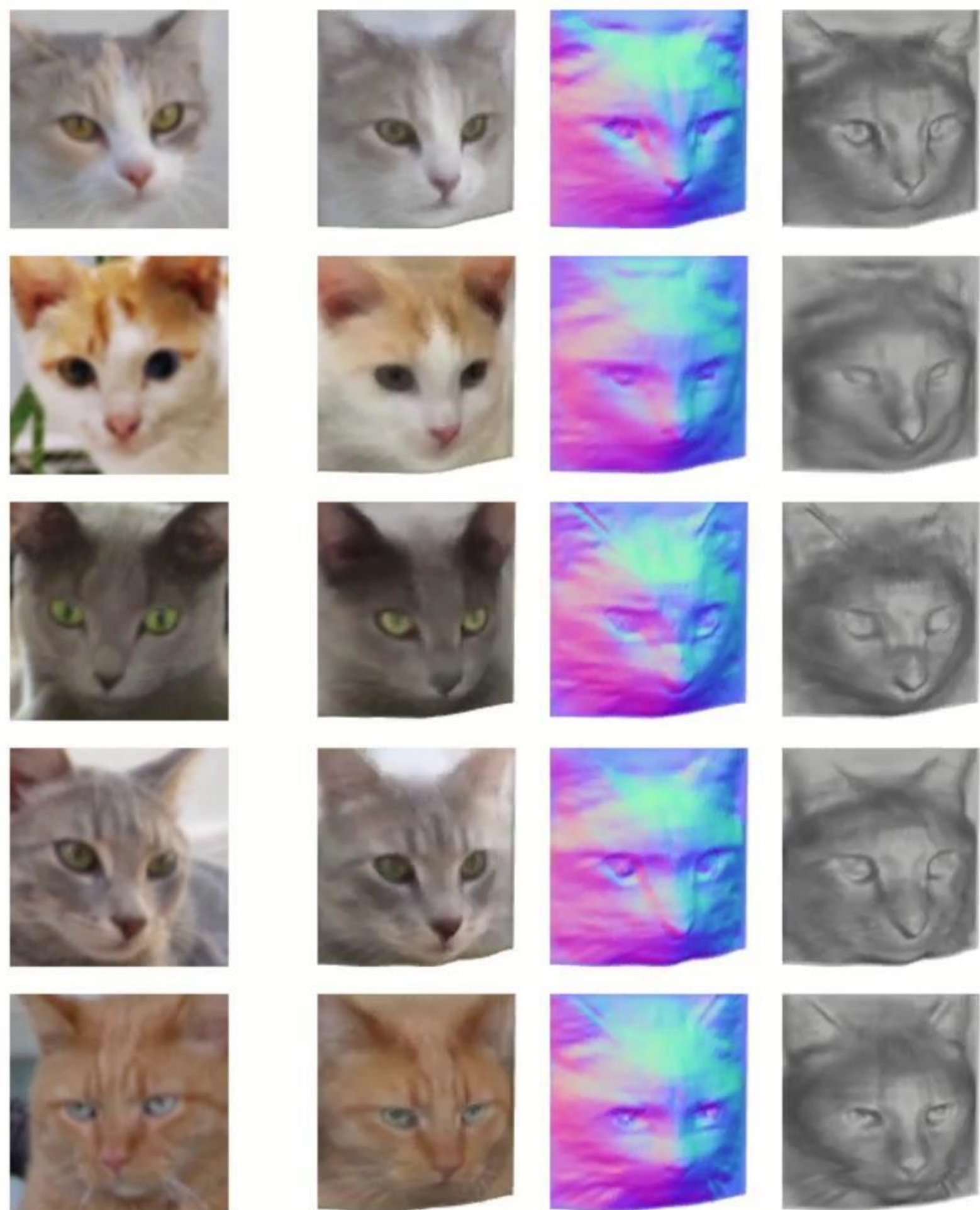
reconstruction



input

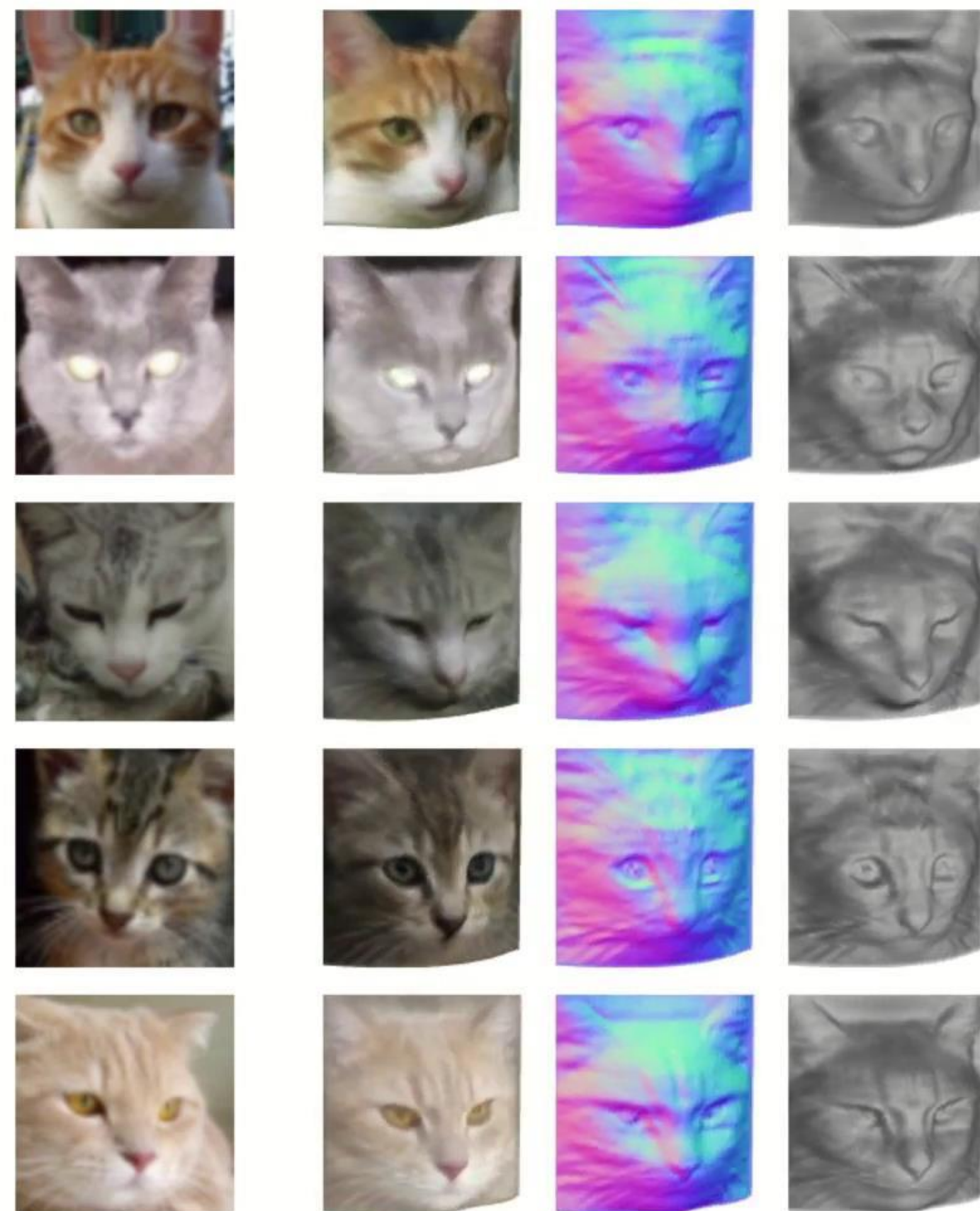
reconstruction





input

reconstruction



input

reconstruction



# INGREDIENTS OF THE BEST PAPER

- 3D
- 2D→3D
- Unsupervised
- Graphics

Well written!



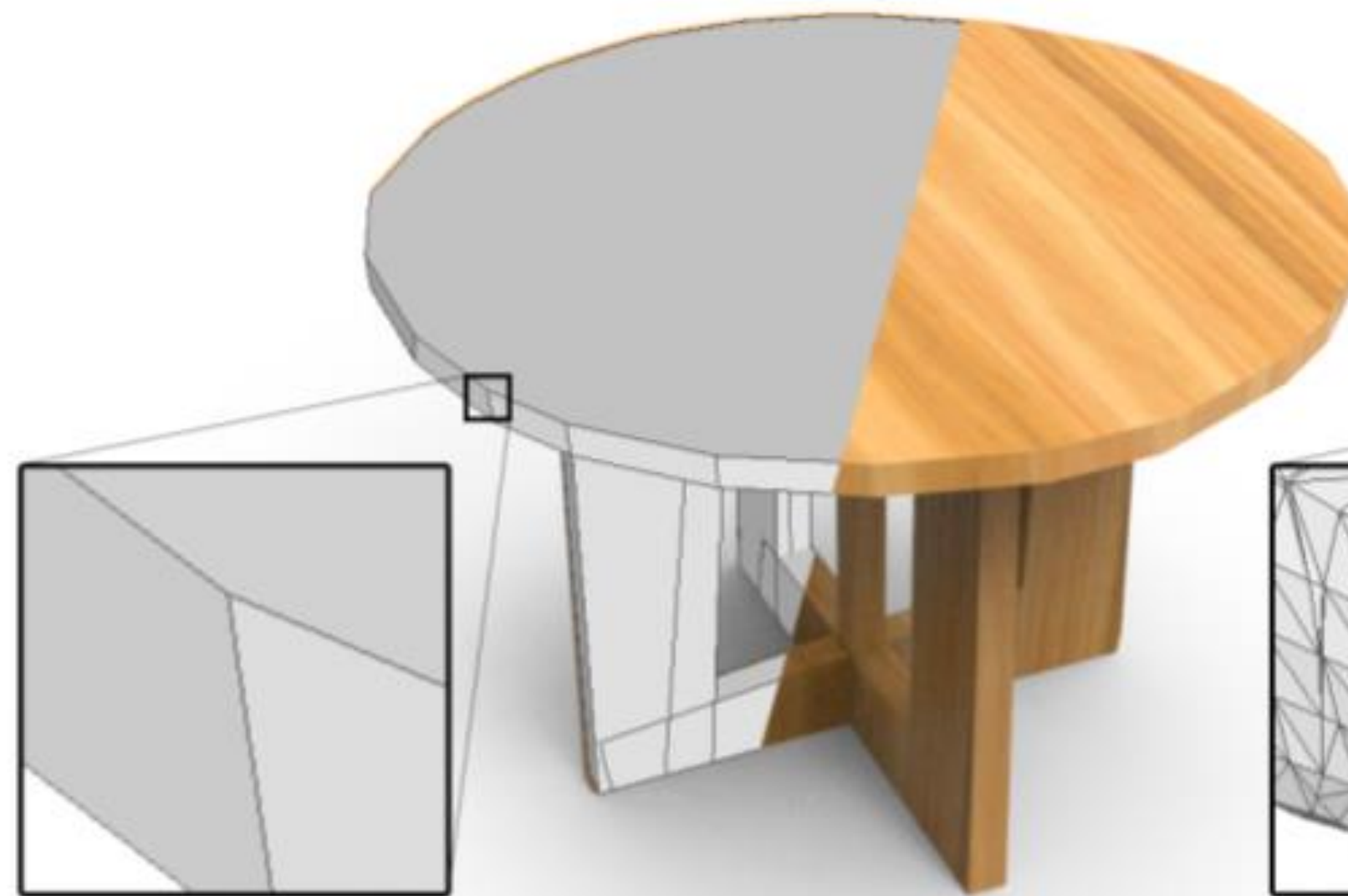
# BEST STUDENT PAPER

## **BSP-Net: Generating Compact Meshes via Binary Space Partitioning**

Zhiqin Chen  
Simon Fraser University

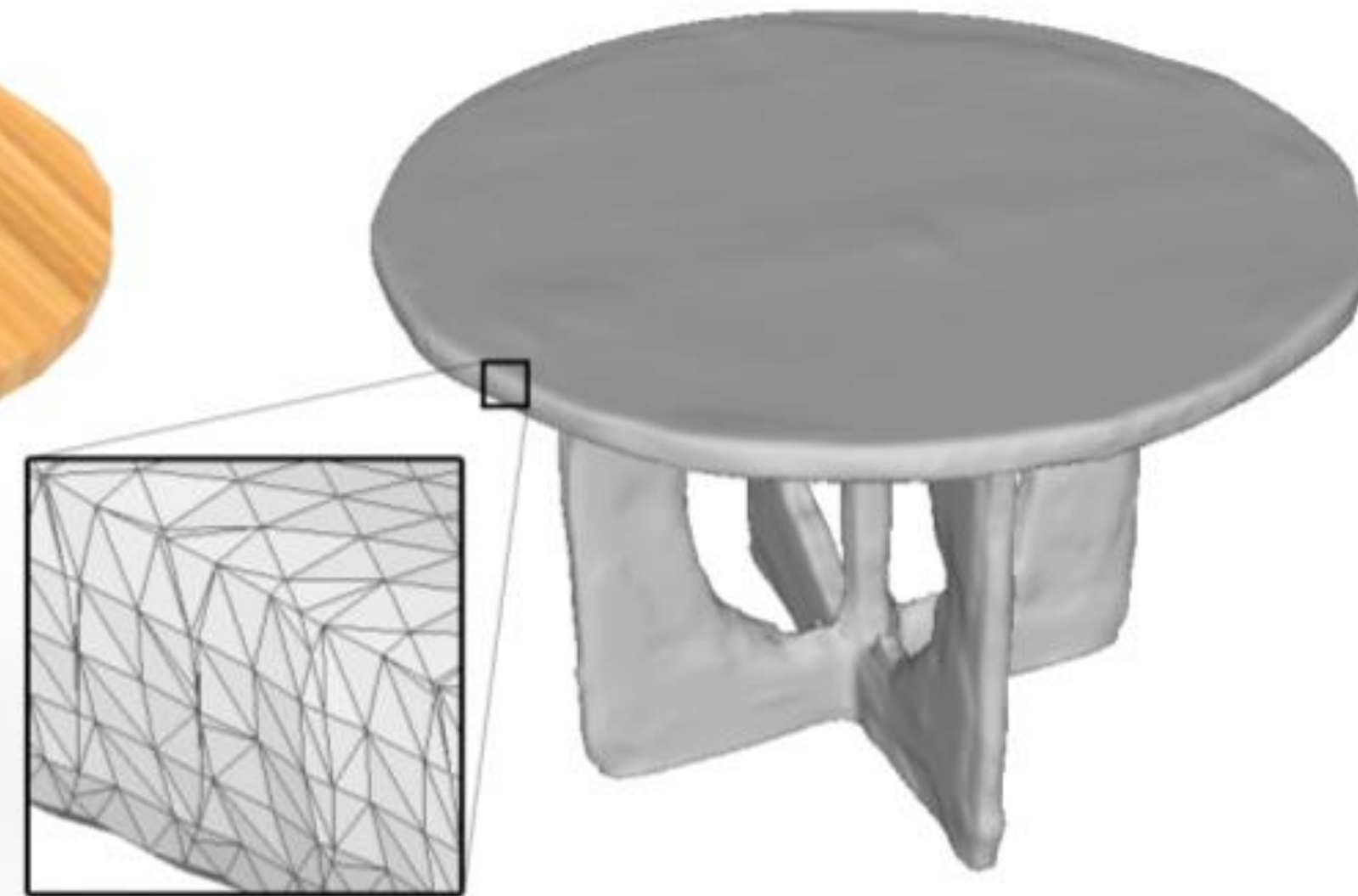
Andrea Tagliasacchi  
Google Research

Hao Zhang  
Simon Fraser University



**(a) BSP-Net output**

(392 vertices, 219 polygons or 600 triangles)



**(b) IM-NET output**

(sampled at  $256^3$ , 91,542 vertices, 183,096 triangles)



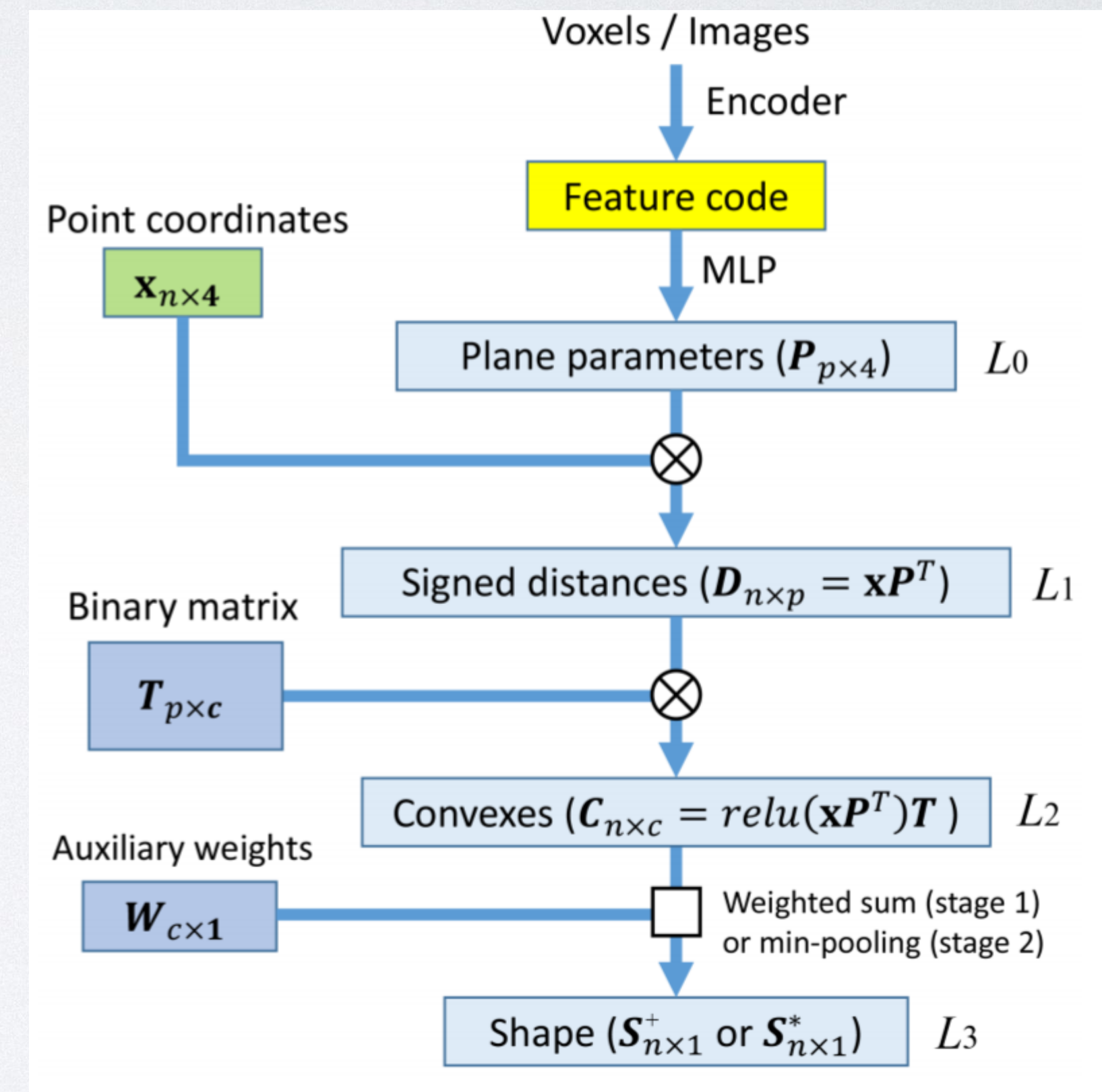
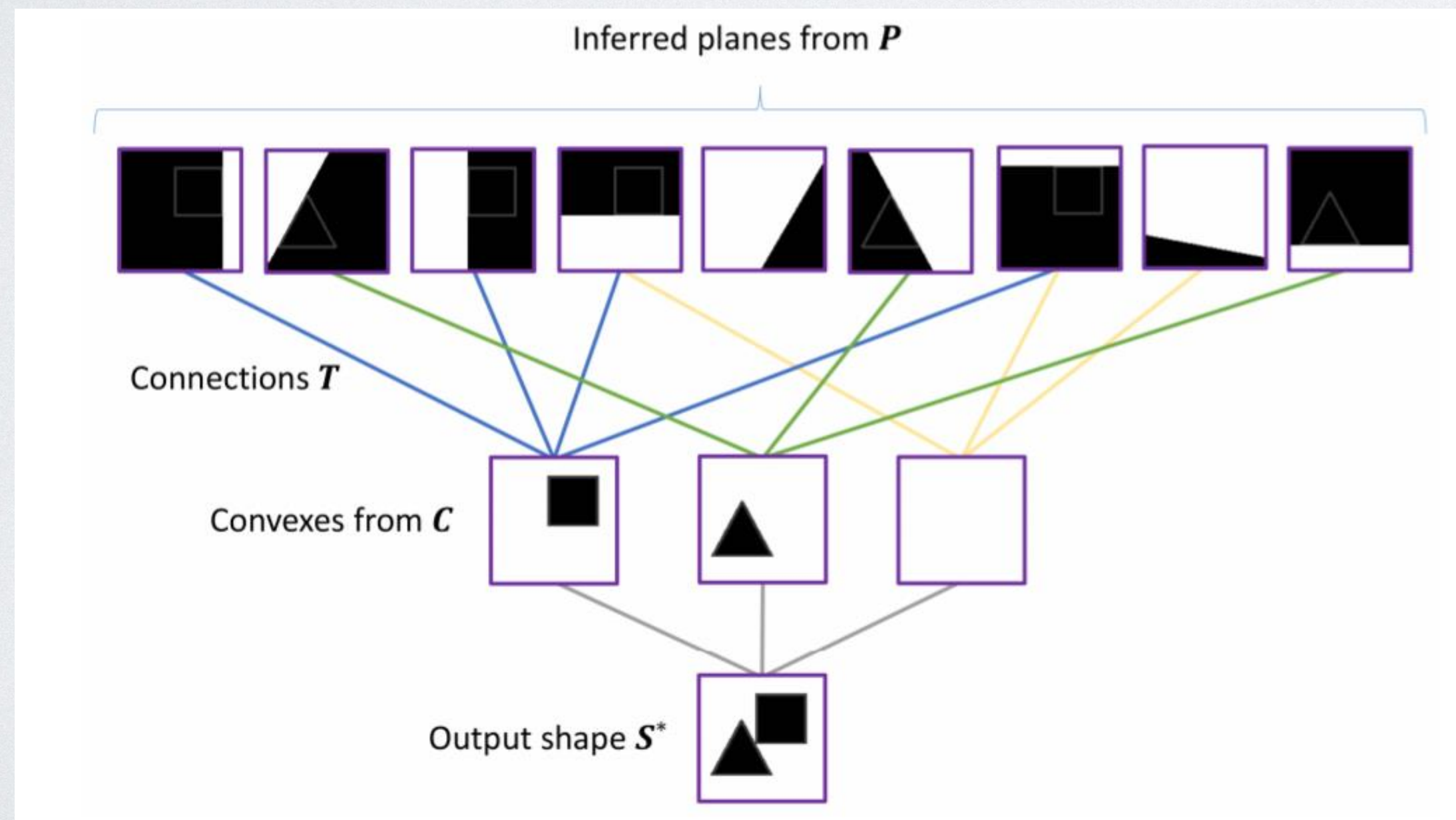
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### **Contributions.**

- BSP-Net is the first deep generative network which directly outputs compact and watertight polygonal meshes with arbitrary topology and structure variety.
- The learned BSP-tree allows us to infer both shape segmentation and part correspondence.
- By adjusting the encoder of our network, BSP-Net can also be adapted for shape auto-encoding and single-view 3D reconstruction (SVR).
- To the best of our knowledge, BSP-Net is among the first to achieve *structured* SVR, reconstructing a *segmented* 3D shape from a single unstructured object image.
- Last but not the least, our network is also the first which can reconstruct and recover sharp geometric features.



# 关于CV发展的趋势的探讨

## 面向的任务:

- 3D
- Video

## 解决问题的方法:

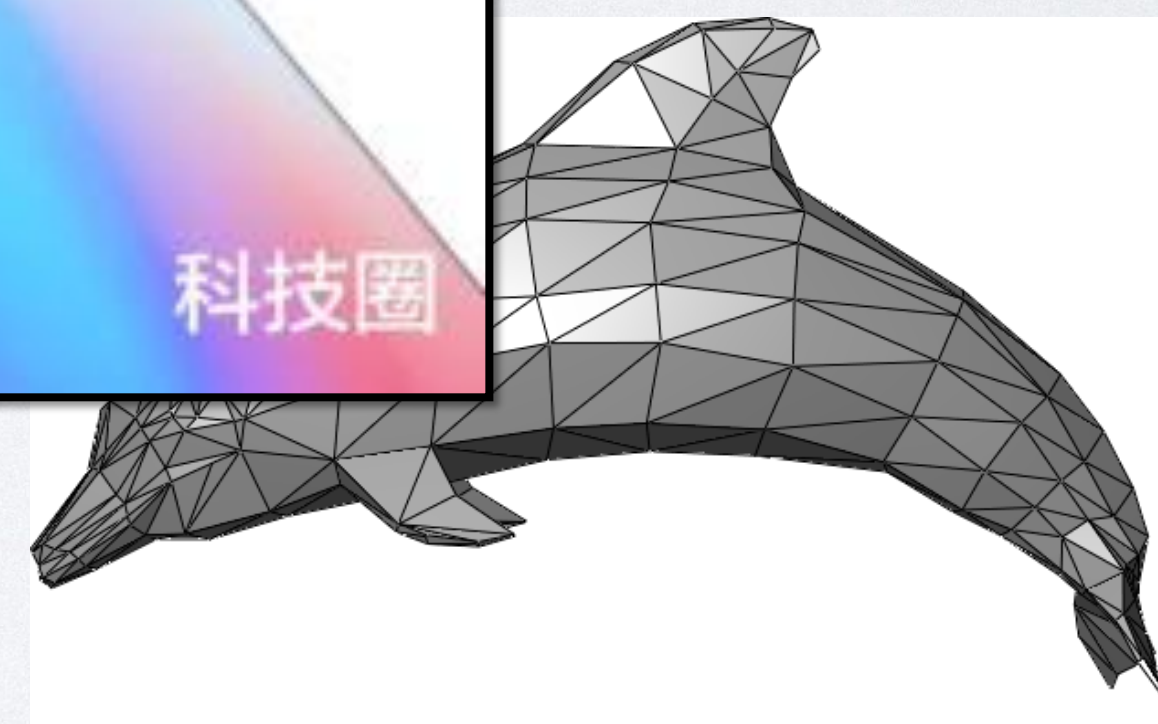
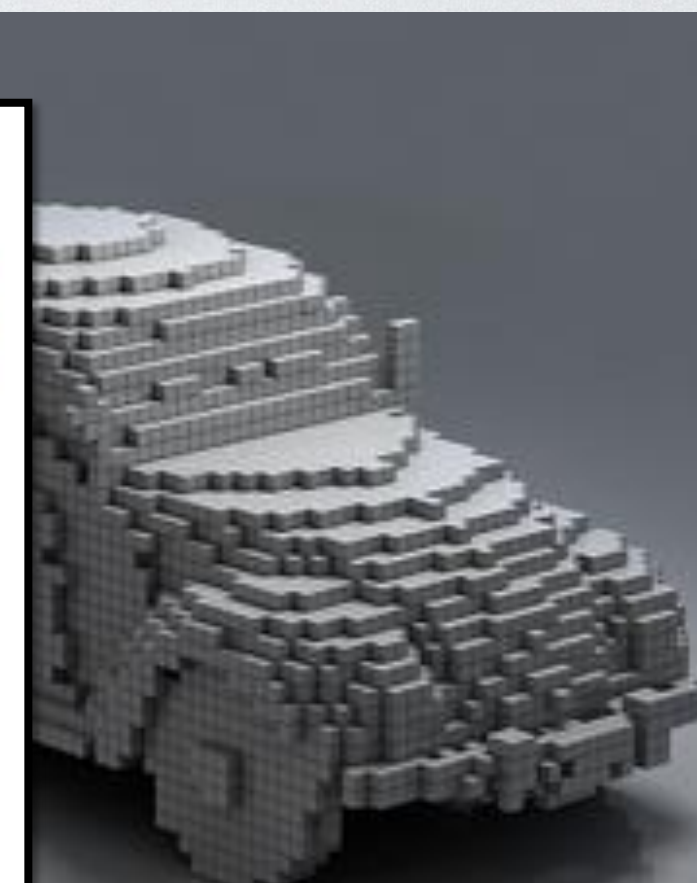
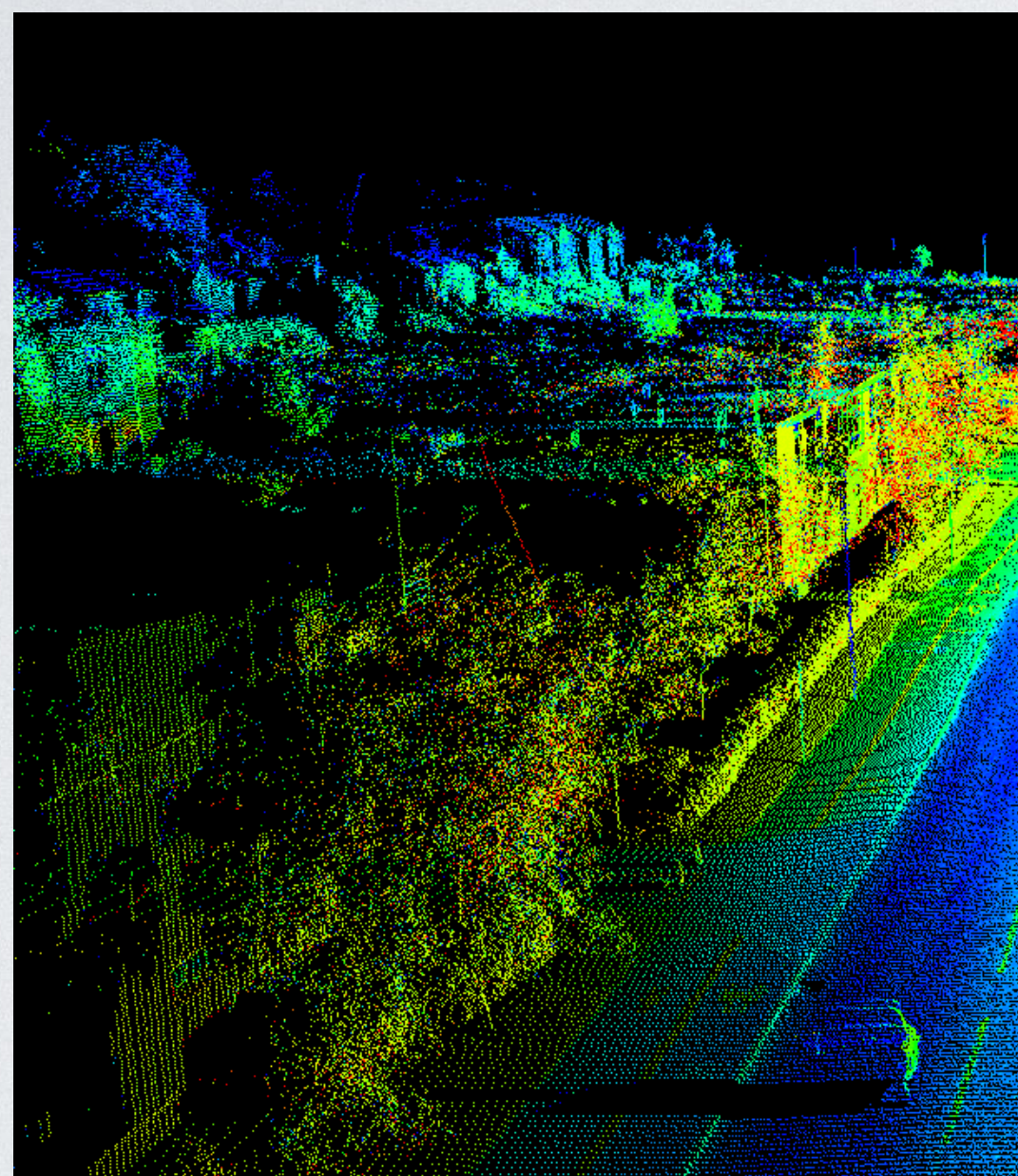
- Holistic
- Cross modality
- X learning (self-supervised, unsupervised, fair, robust, life-long, ...)

## 最终目标

- Weak supervision
- Robust
- Intelligent



# 3D VISION: 世界是三维的





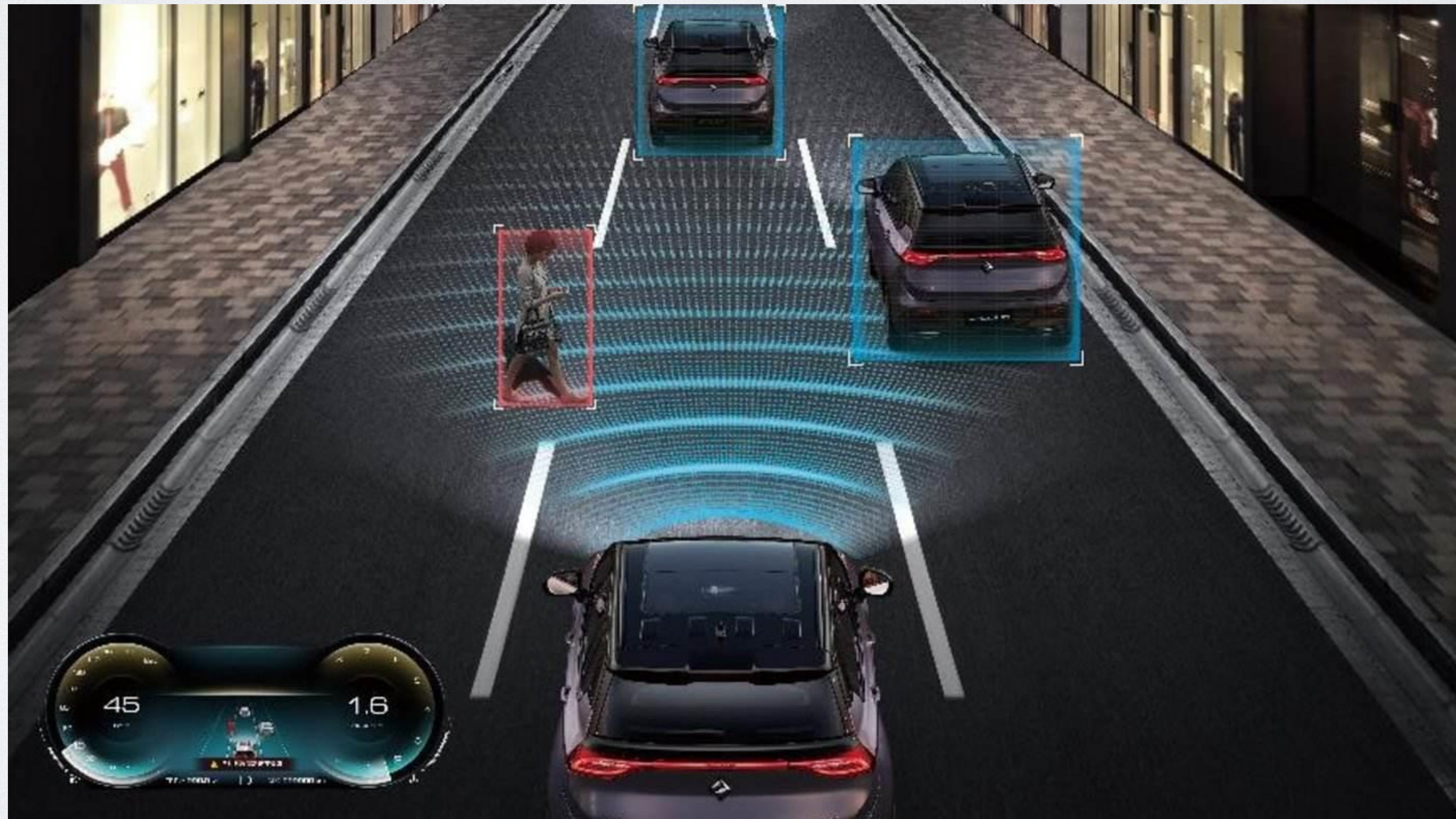
# VIDEO: 世界是动态的





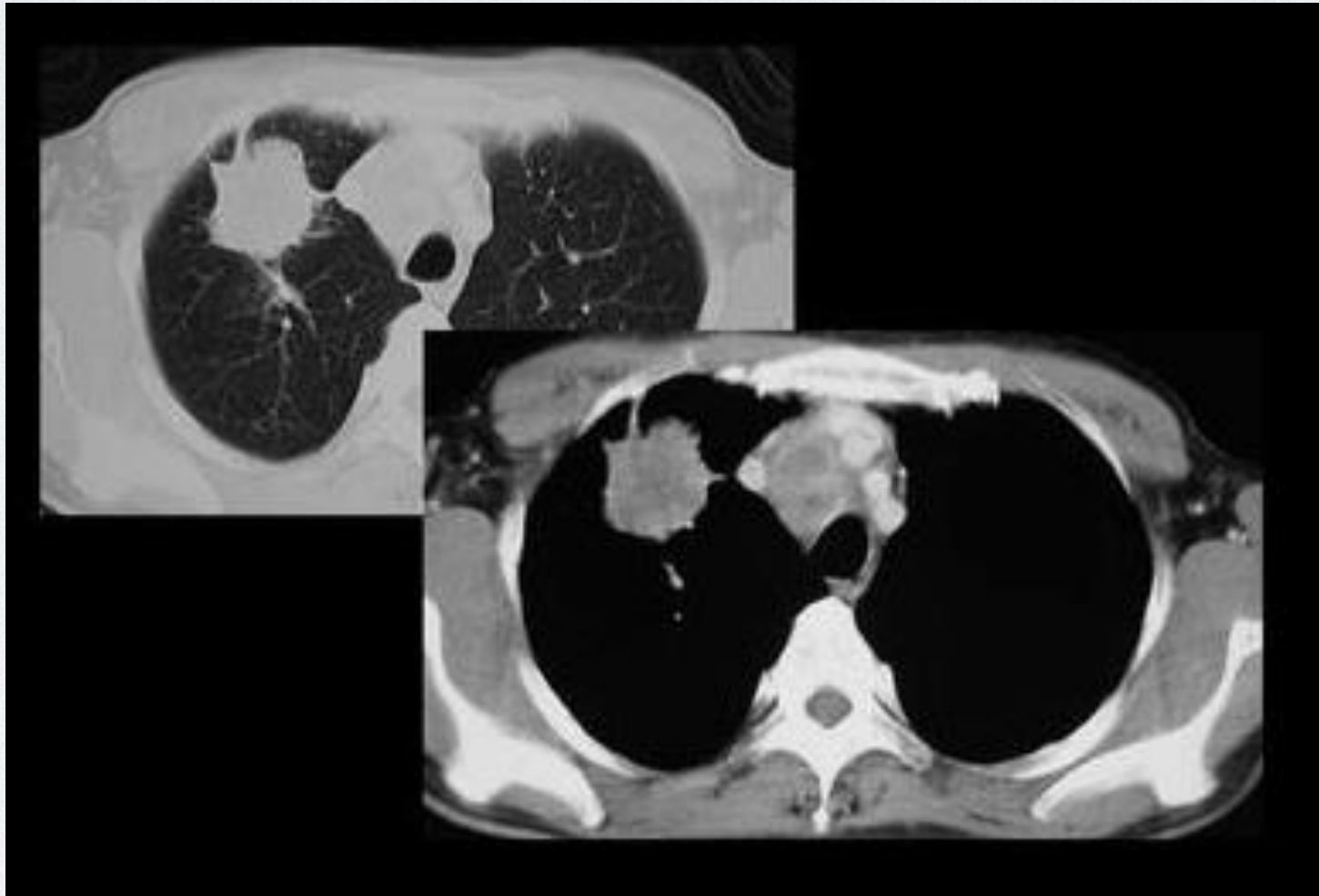
# HOLISTIC VISION

Recognition, object detection, semantic/instance segmentation, 3D reconstruction, ...





# 跨模态学习



医疗机构 \_\_\_\_\_ (组织机构代码: \_\_\_\_\_)  
医疗付费方式: \_\_\_\_\_ **住院病案首页**  
健康卡号: \_\_\_\_\_ 第 \_\_\_\_\_ 次住院 病案号: \_\_\_\_\_

姓名 \_\_\_\_\_ 性别 \_\_\_\_\_ 出生日期 \_\_\_\_\_ 年 \_\_\_\_\_ 月 \_\_\_\_\_ 日 年龄 \_\_\_\_\_ 国籍 \_\_\_\_\_  
(年龄不足一周岁的) 年龄 \_\_\_\_\_ 月 新生儿出生体重 \_\_\_\_\_ 克 新生儿入院体重 \_\_\_\_\_ 克  
出生地 \_\_\_\_\_ 省(区、市) \_\_\_\_\_ 市 \_\_\_\_\_ 县 籍贯 \_\_\_\_\_ 省(区、市) \_\_\_\_\_ 市  
民族 \_\_\_\_\_ 身份证号 \_\_\_\_\_ 职业 \_\_\_\_\_ 婚姻 \_\_\_\_\_  
现住址 \_\_\_\_\_ 省(区、市) \_\_\_\_\_ 市 \_\_\_\_\_ 县  
电话 \_\_\_\_\_ 邮编 \_\_\_\_\_  
户口地址 \_\_\_\_\_ 省(区、市) \_\_\_\_\_ 市 \_\_\_\_\_ 县  
邮编 \_\_\_\_\_  
工作单位及地址 \_\_\_\_\_ 单位电话 \_\_\_\_\_ 邮编 \_\_\_\_\_  
联系人姓名 \_\_\_\_\_ 关系 \_\_\_\_\_ 地址 \_\_\_\_\_ 电话 \_\_\_\_\_  
入院途径 \_\_\_\_\_  
入院时间 \_\_\_\_\_ 年 \_\_\_\_\_ 月 \_\_\_\_\_ 日 \_\_\_\_\_ 时 入院科别 \_\_\_\_\_ 病房 \_\_\_\_\_ 转科科别 \_\_\_\_\_  
出院时间 \_\_\_\_\_ 年 \_\_\_\_\_ 月 \_\_\_\_\_ 日 \_\_\_\_\_ 时 出院科别 \_\_\_\_\_ 病房 \_\_\_\_\_ 实住院 \_\_\_\_\_ 天  
门(急)诊诊断 \_\_\_\_\_ 疾病编码 \_\_\_\_\_

	出院诊断	疾病编码	入院情况	出院诊断	疾病编码	入院情况
主要诊断:						
其他诊断:						





# X LEARNING

- Self-supervised learning
- Unsupervised learning
- Meta learning
- Life-long learning
- Robust learning
- Transfer learning
- ...



THANKS  
&  
QUESTIONS?