Amodal Completion
via Progressive MC Diffusion

CV심화 김수란

Table of contents

I. Introduction

II. Method

III. Experiments

IV. Discussion

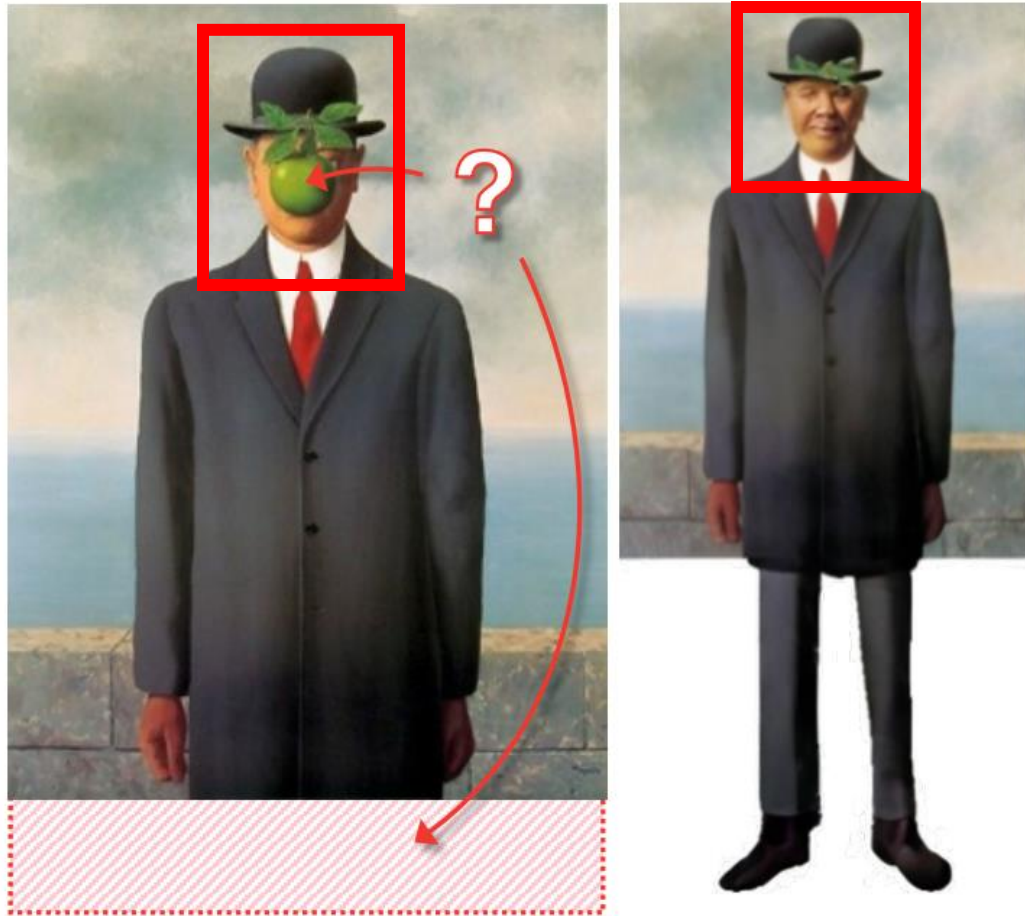# I. Introduction

I. Introduction

What is Amodal completion?

The ability to see an entire object despite parts of it being covered by another object in front of it.
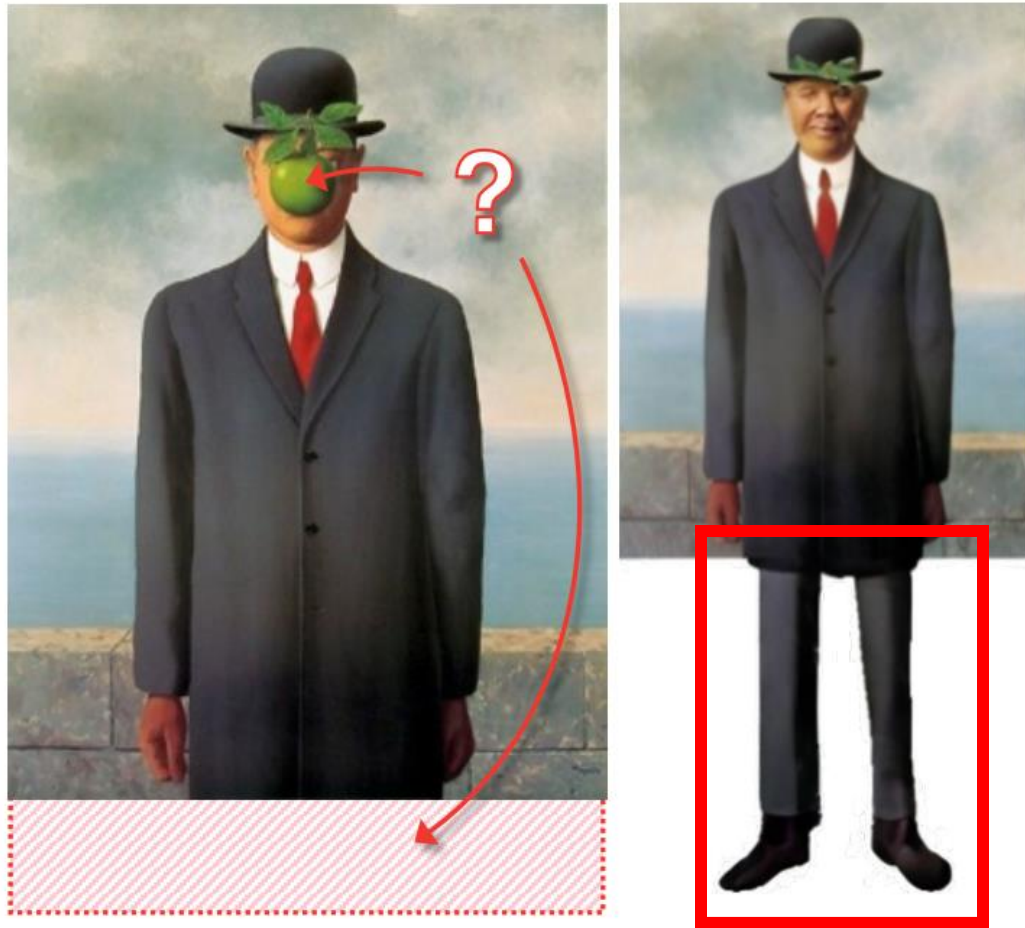
Task & Previous Approaches

Fill in the hidden regions of occluded objects

- Two-step approach
  1. Completing a binary amodal mask
  2. Synthesizing RGB pixel values within the mask

  ->directly regressing the amodal mask is an ill-posed formulation due to the diversity of possible completions
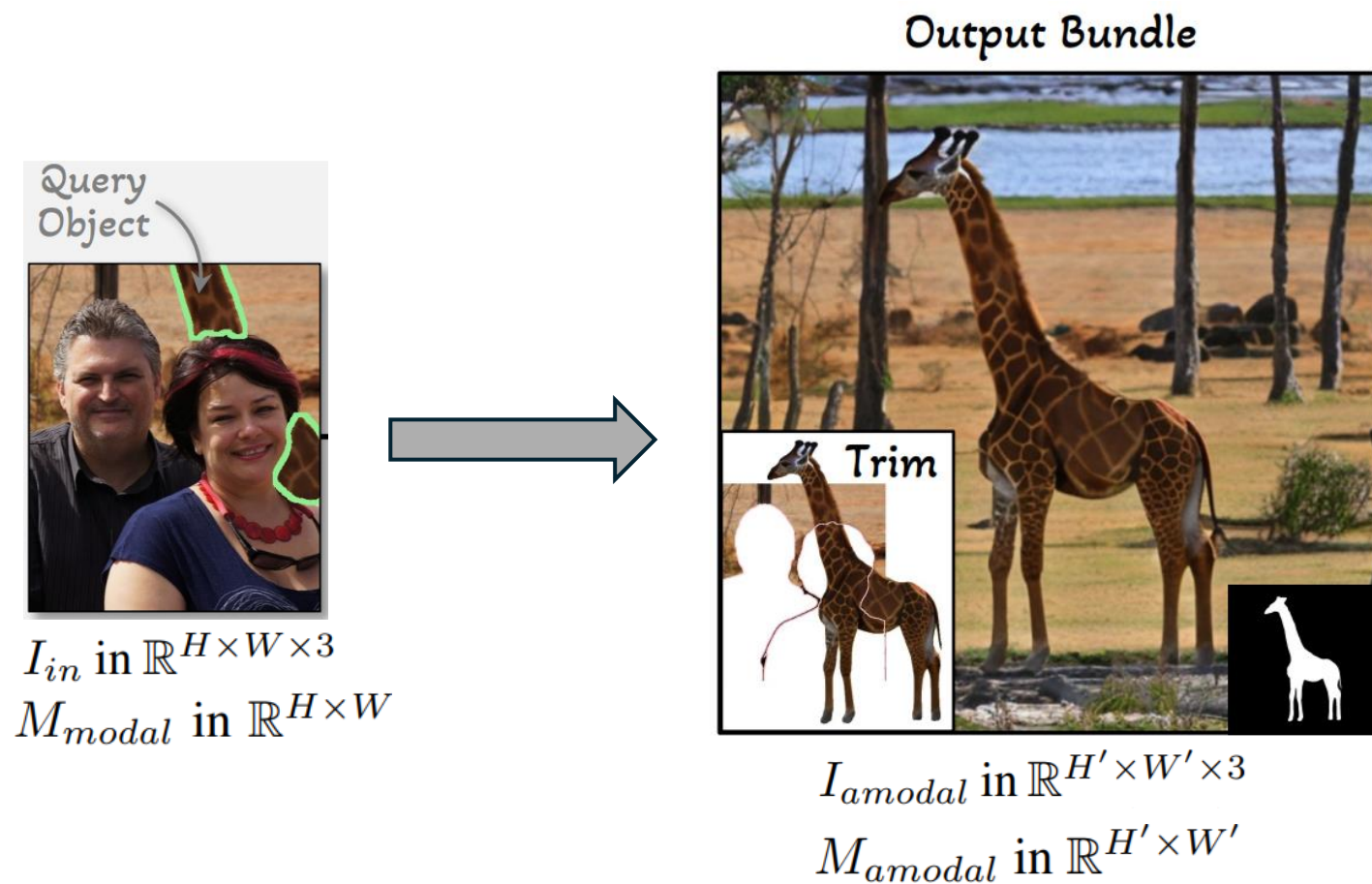
Previous Approaches vs. Our Approach

Fill in the hidden regions of occluded objects

- Two-step approaches
  1. Computing a binary amodal mask
  2. Synthesizing pixel values within the mask

II. Method

Problem Setup

I_{in} in $\mathbb{R}^{H \times W \times 3}$

M_{modal} in $\mathbb{R}^{H \times W}$

I_{amodal} in $\mathbb{R}^{H' \times W' \times 3}$

M_{amodal} in $\mathbb{R}^{H' \times W'}$

$$I_{out} = F_{s \to e}(I_{in}, M_{in}, P)$$

Progressive MC Diffusion

① **Progressive** Occlusion-aware Completion

+

② Mixed Context **(MC) Diffusion** Sampling

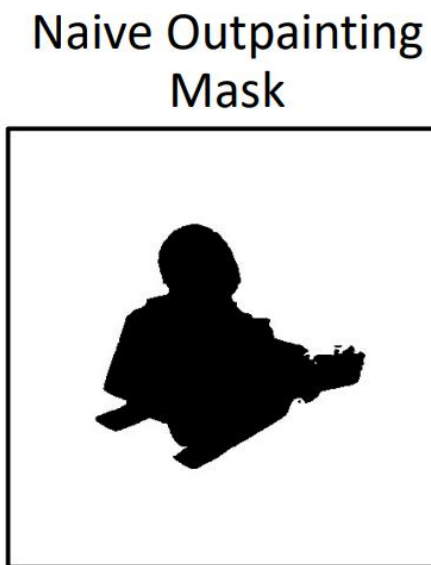# Naive Outpainting vs. Our Approach

$$I_{amodal} = F_{0 \to N}(I_{in}, 1 - M_{modal}, P)$$

$$I_{amodal} = F_{0 \to N}(I_{in}, M_{occ}, P)$$

Original

Naive Outpainting Mask
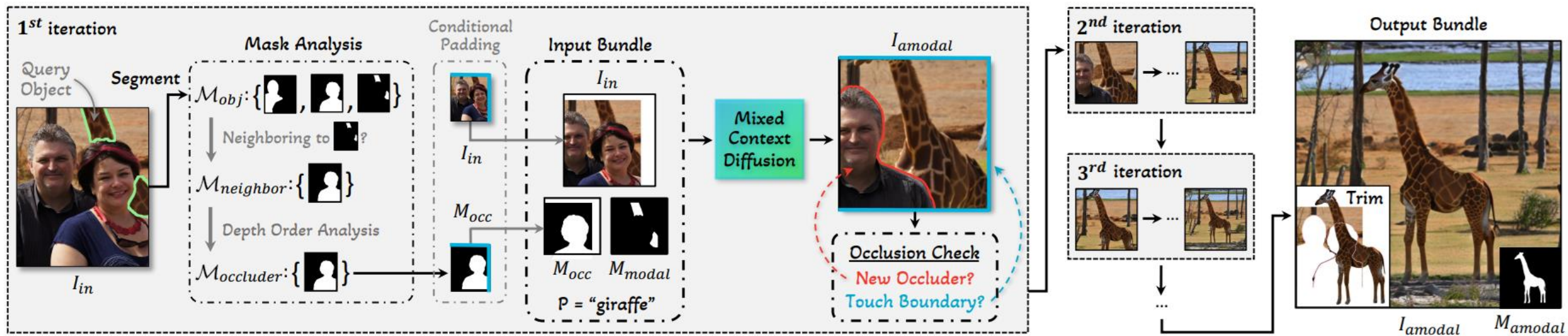
Naive Outpainting Output

Ours

Overextension
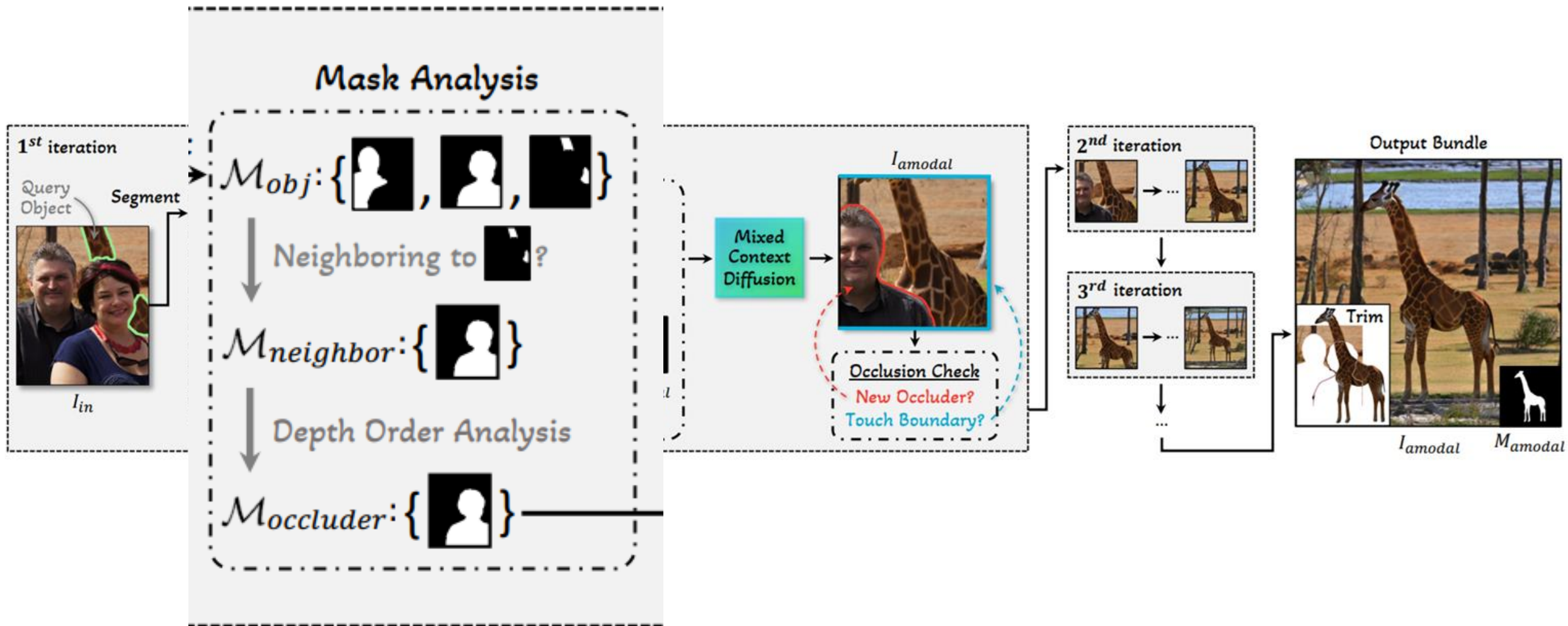Orientation changed

Identity preservation
Orientation maintained

II. Method

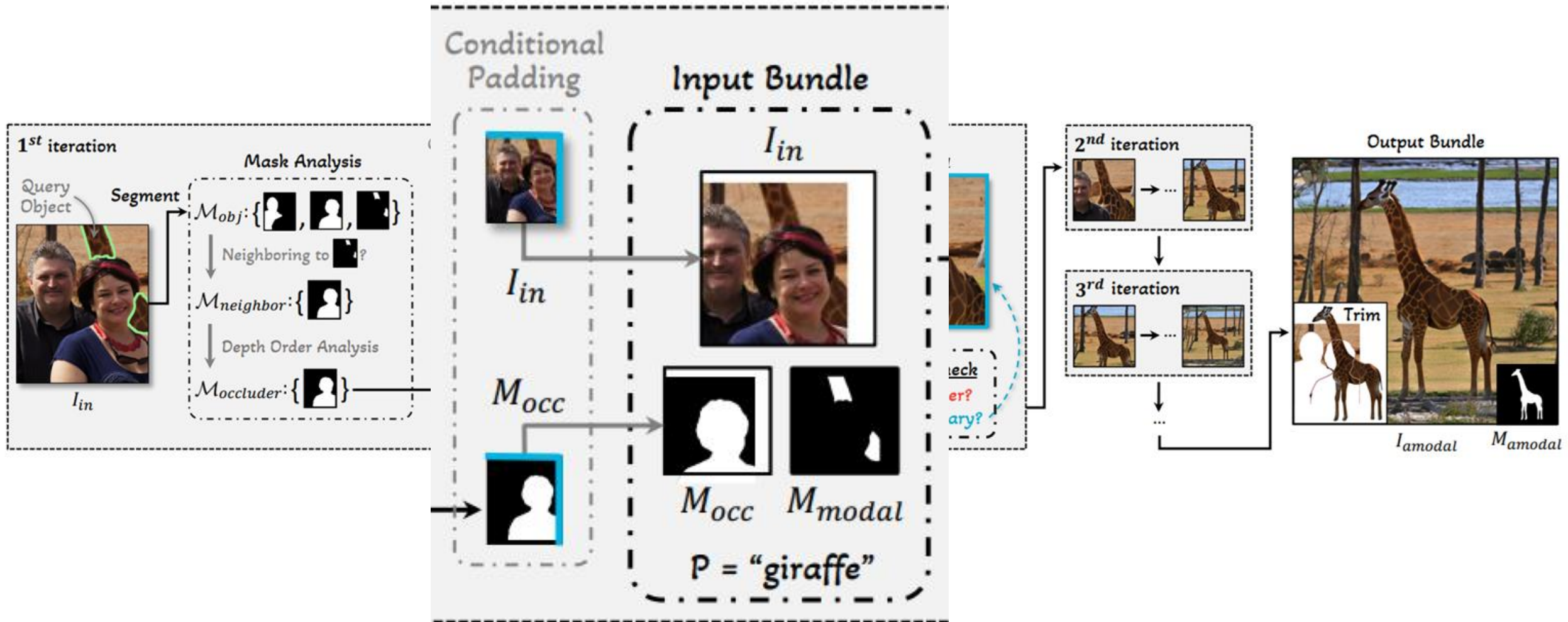## ① **Progressive Occlusion-aware Completion**

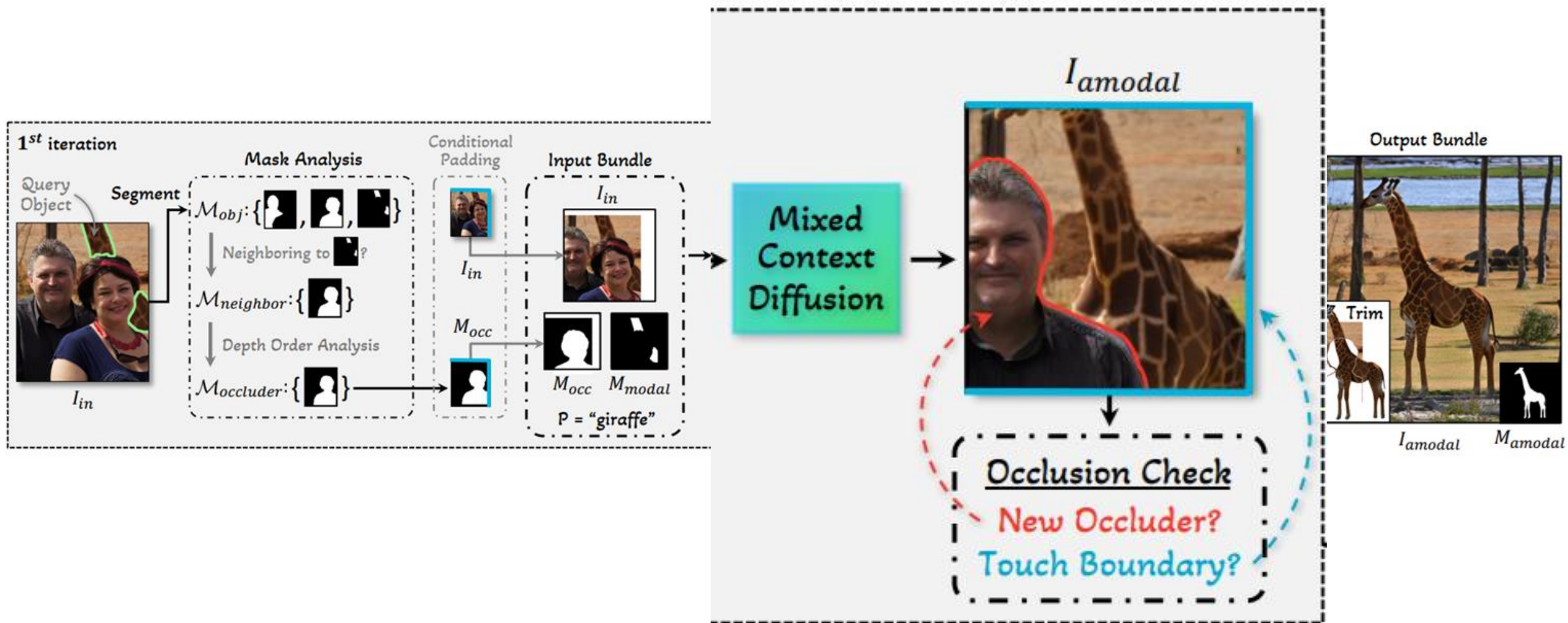# ① Progressive Occlusion-aware Completion

① Progressive Occlusion-aware Completion

① Progressive Occlusion-aware Completion

① Progressive Occlusion-aware Completion

Co-occurrence Problem
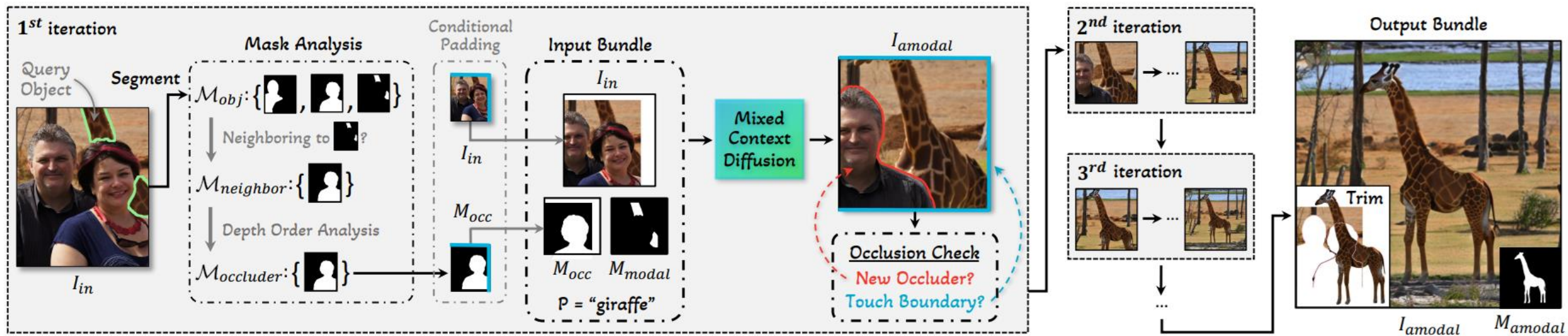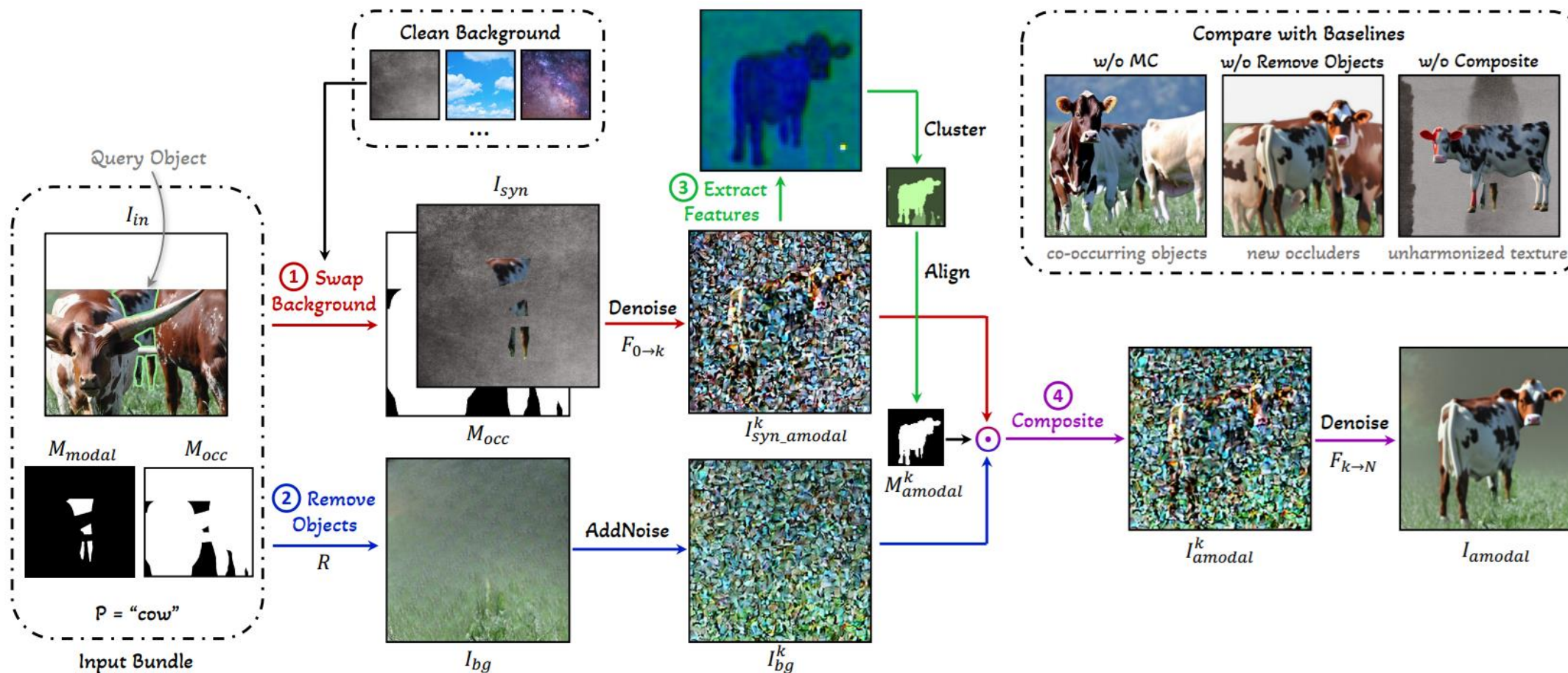

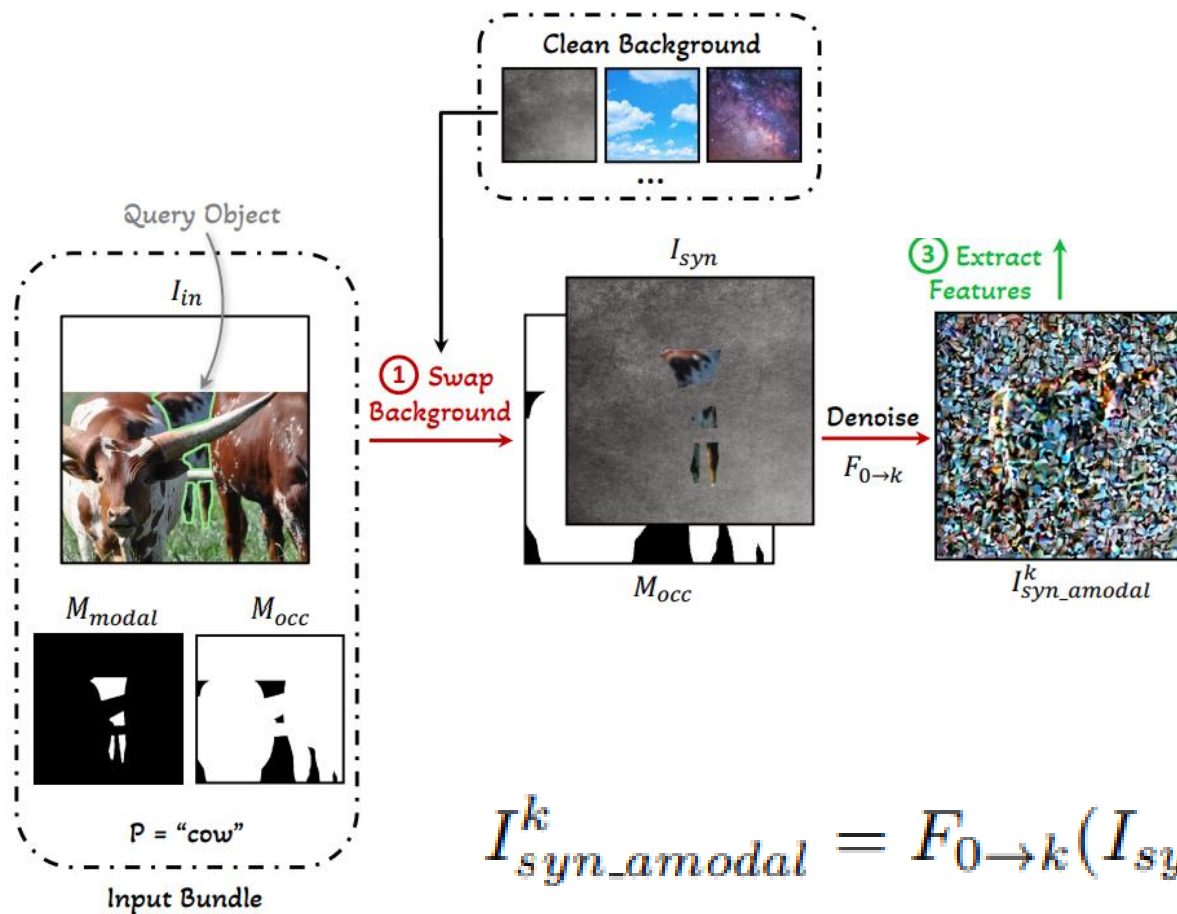Directly using a pre-trained diffusion inpainting model?
-> Co-occurrence problem

② Mixed Context (MC) Diffusion Sampling

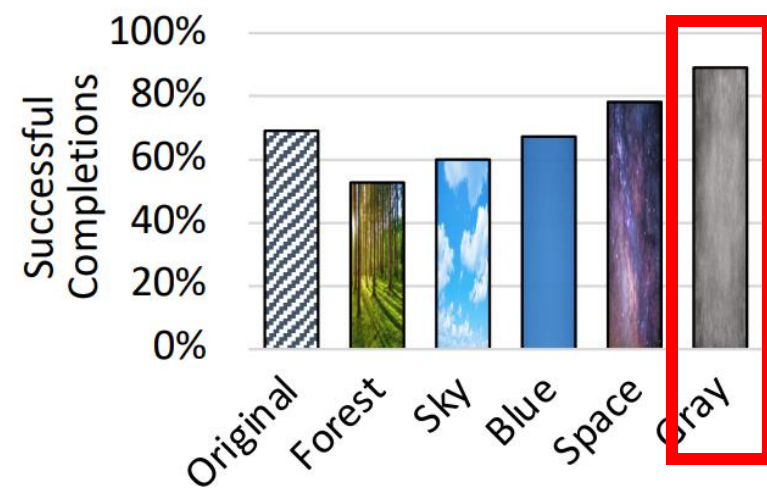Clean Background

Query Object

I_{in}

① Swap Background

I_{syn}

③ Extract Features

Cluster

Denoise $F_{0 \to k}$

Align

M_{modal} M_{occ}

② Remove Objects R

M_{occ}

$I_{syn\_amodal}^{k}$

M_{amodal}^{k}

④ Composite

I_{amodal}^{k}

Denoise $F_{k \to N}$

I_{amodal}

P = "cow"

Input Bundle

AddNoise

I_{bg}

I_{bg}^{k}

Compare with Baselines

w/o MC   w/o Remove Objects   w/o Composite

co-occurring objects   new occluders   unharmonized texture

② Mixed Context (MC) Diffusion Sampling

Ablation study

$$I^k_{syn\_amodal} = F_{0 \to k}(I_{syn}, M_{occ}, P)$$

② Mixed Context (MC) Diffusion Sampling

Query Object

I_{in}

M_{modal} M_{occ}

P = "cow"

Input Bundle

② Remove Objects

R

AddNoise

I_{bg}

I_{bg}^{k}

$$I_{bg}^{k} = \text{AddNoise}(R(I_{in}, M_{modal} + M_{occ}), k)$$

② Mixed Context (MC) Diffusion Sampling

Cluster

③ Extract Features

Align

Composite

$I_{syn\_amodal}^{k}$

M_{amodal}^{k}

I_{bg}^{k}

I_{amodal}^{k}

I_{in}

I_{syn}

$I_{syn\_amodal}^{k}$

Clusters

M_{amodal}^{k}

I_{amodal}

E_1 E_2 D_2 D_3 D_4
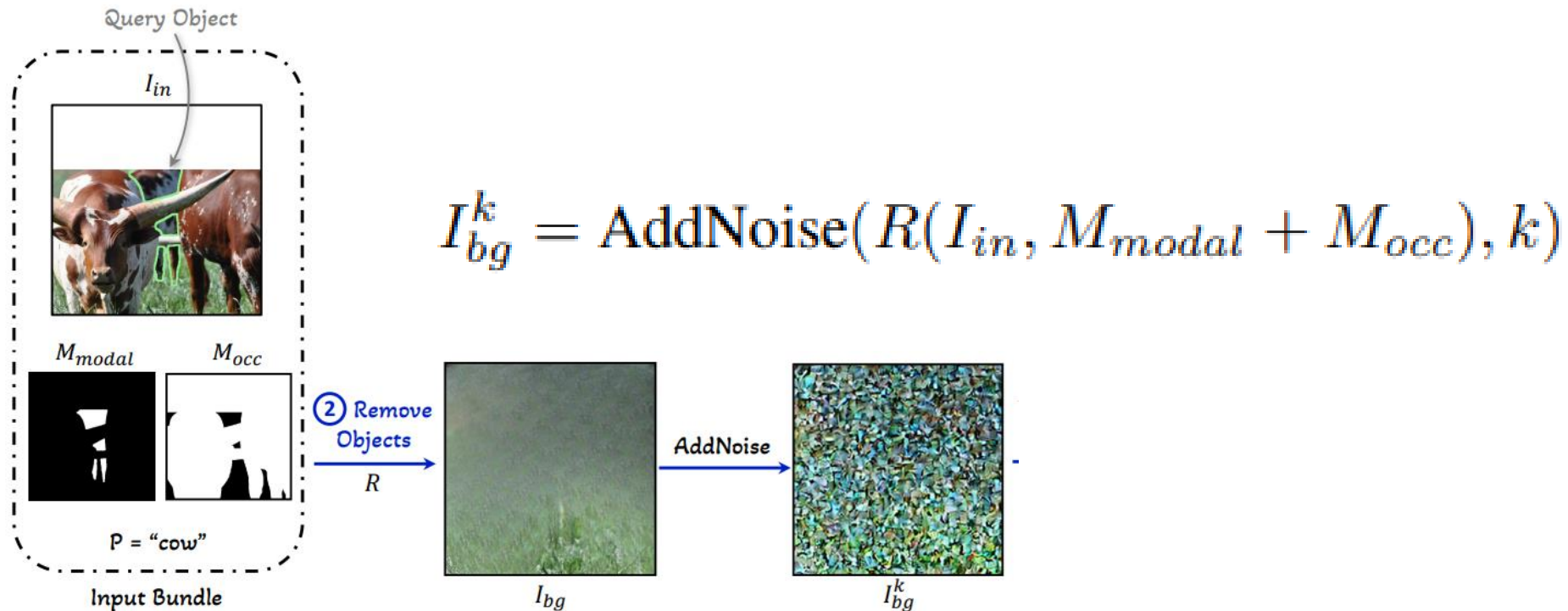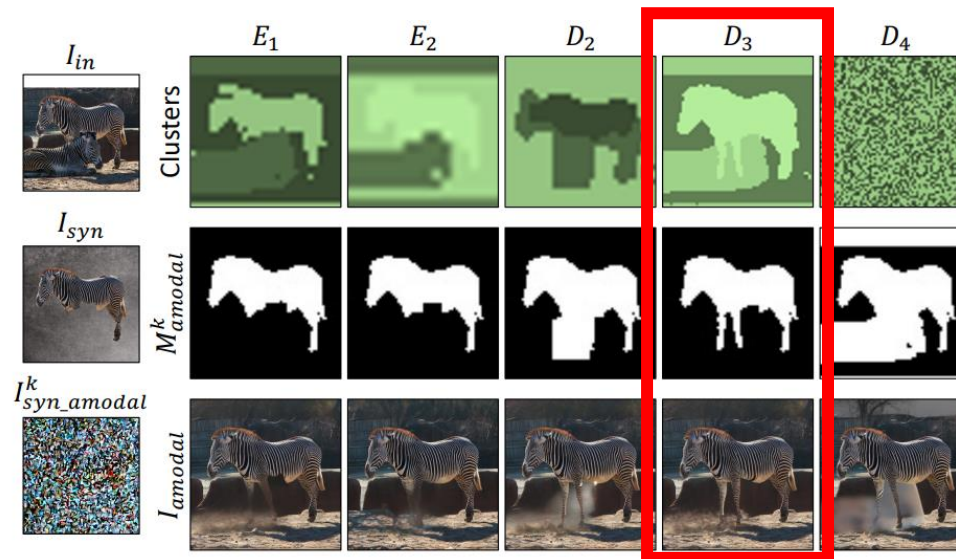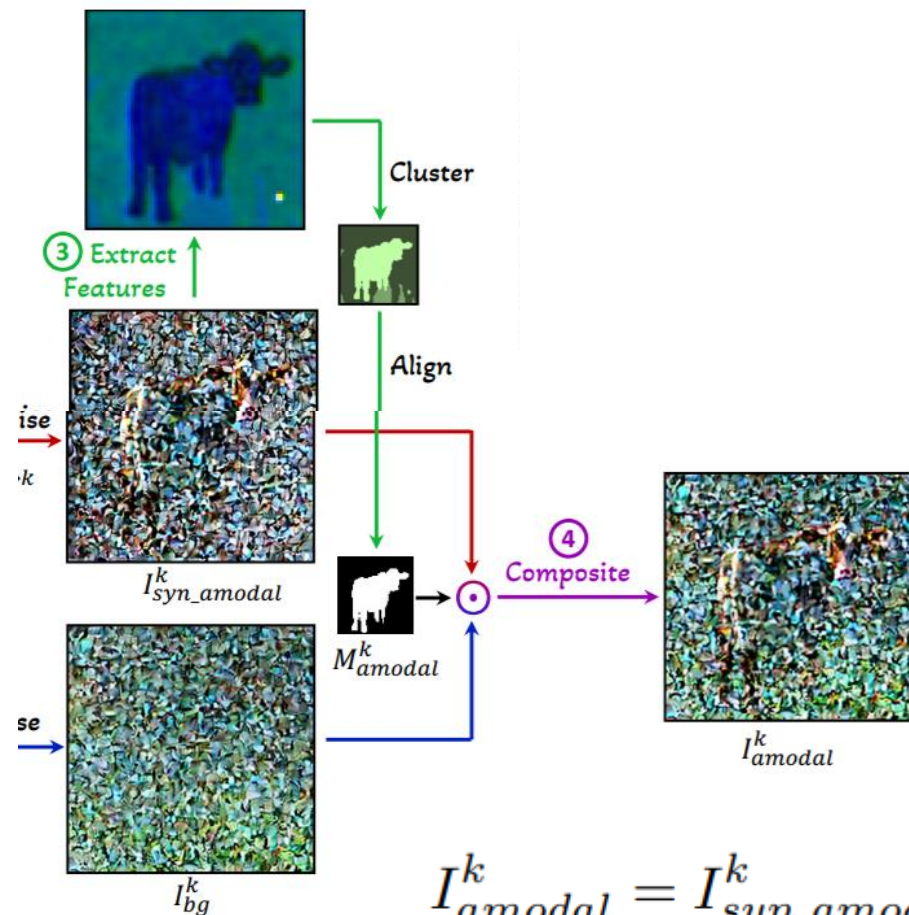
Ablation study

$$I_{amodal}^{k} = I_{syn\_amodal}^{k} \odot M_{amodal}^{k}$$
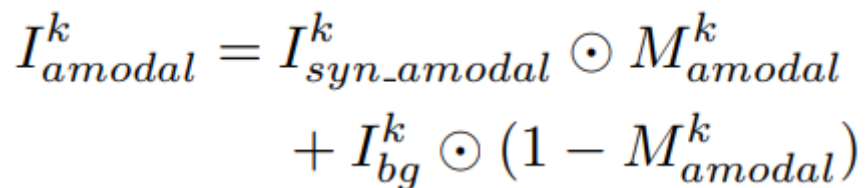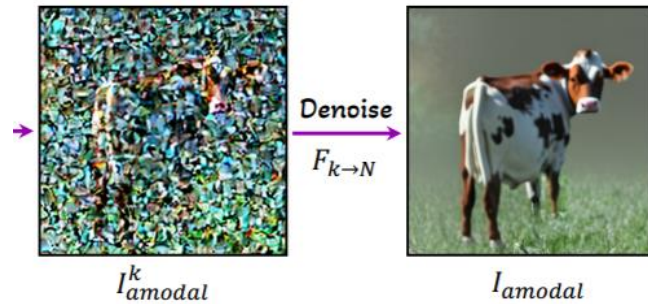$$+ I_{bg}^{k} \odot (1 - M_{amodal}^{k})$$

② Mixed Context (MC) Diffusion Sampling

Ablation study

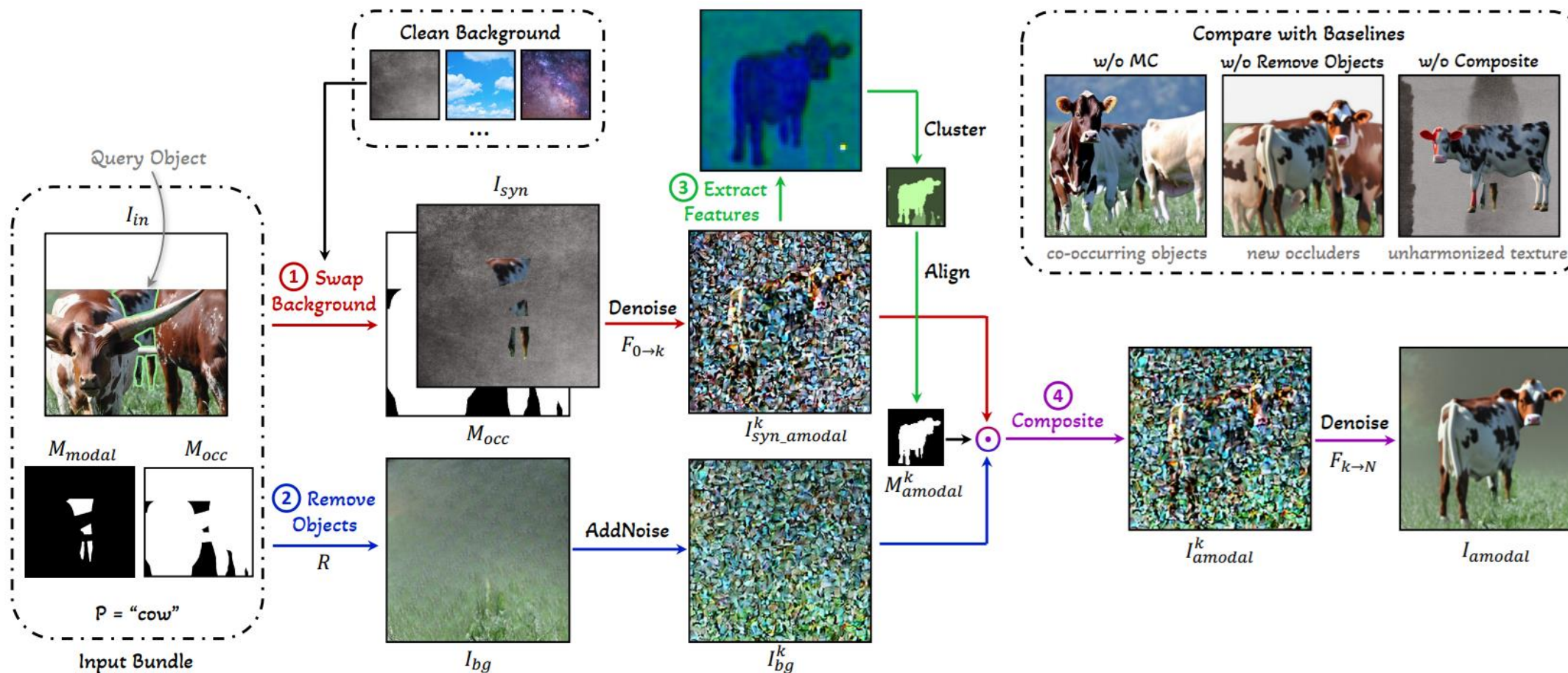$$I^k_{amodal} = I^k_{syn\_amodal} \odot M^k_{amodal}$$
$$+ I^k_{bg} \odot (1 - M^k_{amodal})$$

② Mixed Context (MC) Diffusion Sampling

$$I_{amodal} = F_{k \to N}(I^k_{amodal}, M_{occ}, P)$$

② Mixed Context (MC) Diffusion Sampling

Counterfactual Completion Curation System

Mask extends 10.8% → complete   Mask extends 36.6% → incomplete
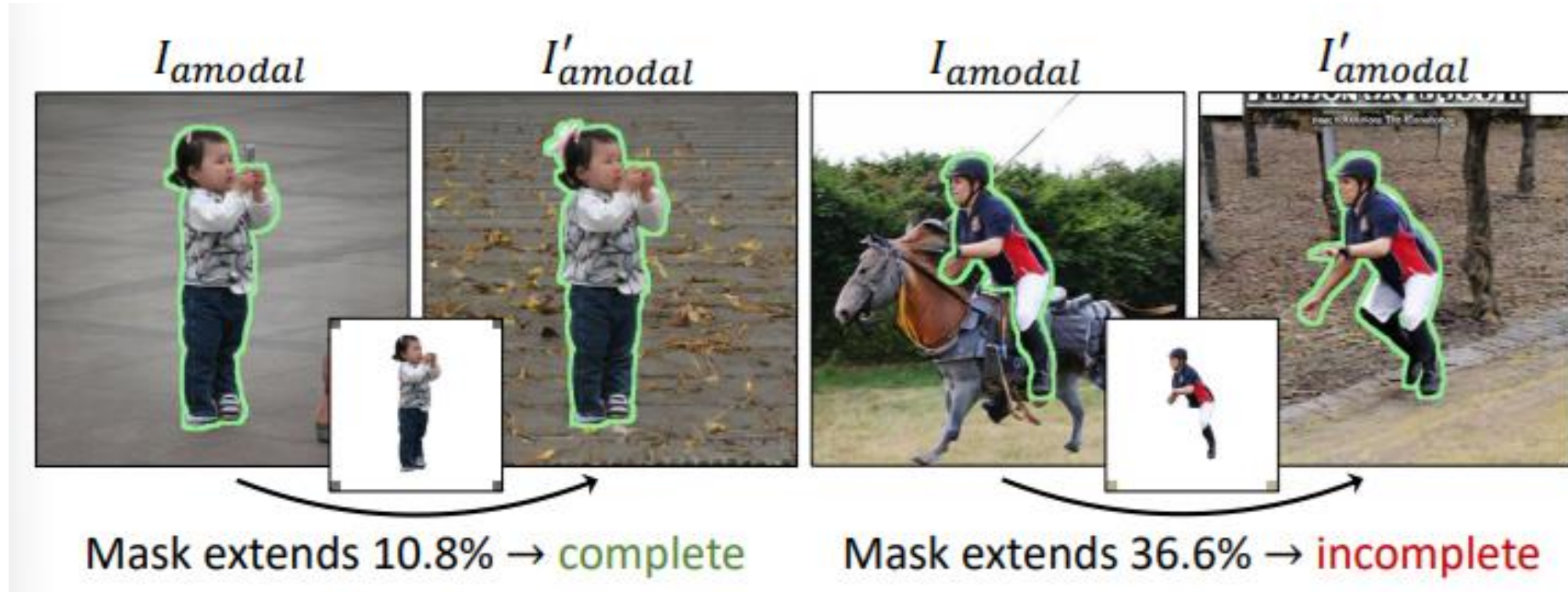
III. Experiments

Comparisons with Previous Methods

Datasets

Comparisons with Previous Methods
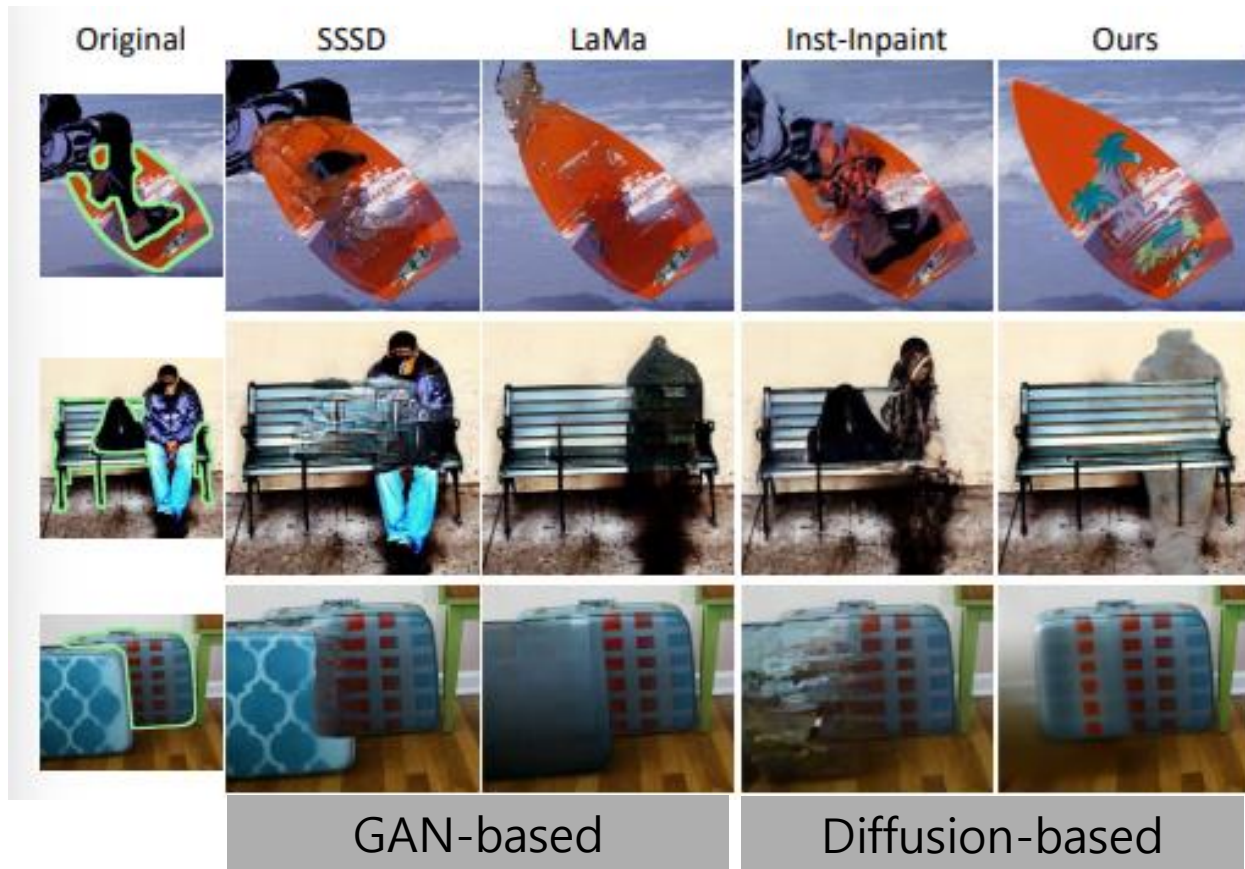
Method	Easy Cases		
	CLIP ↑	DreamSim ↓	LPIPS ↓
SSSD [55]	0.280 / 0.263	0.186 / 0.216	0.096 / 0.142
LaMa [43]	0.288 / 0.265	0.098 / 0.124	**0.054** / 0.091
Inst-Inpaint [52]	0.264 / 0.257	0.325 / 0.304	0.185 / 0.195
Ours	**0.290 / 0.266**	**0.096 / 0.106**	**0.054 / 0.078**

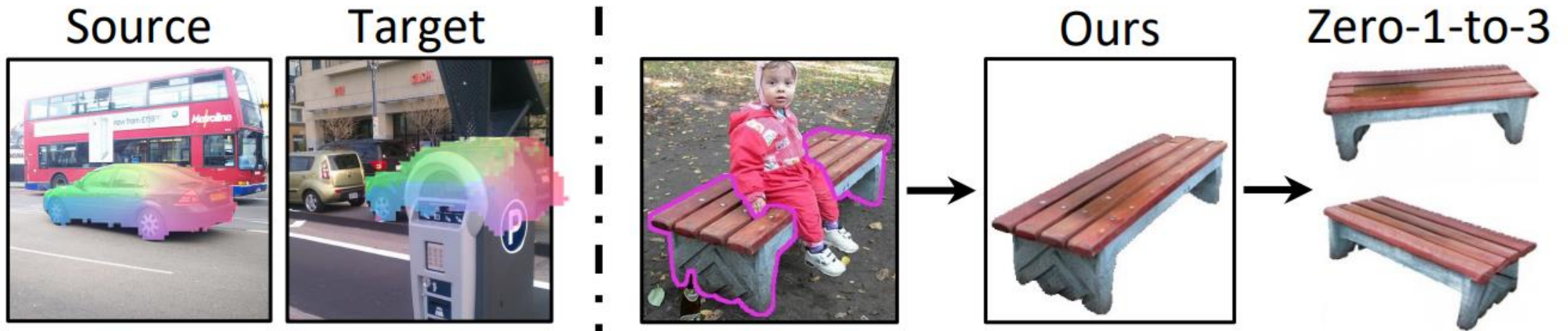| Hard Cases			User Preference
CLIP ↑	DreamSim ↓	LPIPS ↓	
0.267 / 0.263	0.315 / 0.334	0.166 / 0.225	1.8%
0.279 / **0.268**	0.236 / 0.292	0.130 / 0.205	7.3%
0.252 / 0.254	0.451 / 0.446	0.263 / 0.283	0.0%
0.290 / 0.267	**0.184 / 0.185**	**0.110 / 0.141**	**90.9%**

Comparisons

- Extends objects only where necessary
- Avoid generating co-occurring objects

IV. Discussion

Contributions

Limitations

Enclosed by Occluder   Shadows   Hard Co-occurrence

Thank you