

JUNE 18-22, 2023

CVPR

VANCOUVER, CANADA



GAPartNet

Cross-Category Domain-Generalizable Object Perception and Manipulation via **Generalizable and **A**ctionable **P**arts**

CVPR2023 *Highlight*

Haoran Geng*, Helin Xu*, Chengyang Zhao*
Chao Xu, Li Yi, Siyuan Huang, He Wang†



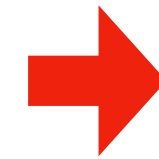
Part classes are more elementary and fundamental than object categories.



Buttons on Remote



Buttons on Microwave



Handles on Furniture



Handles on Refrigerator

Part Definition

Similar geometry

Generalizable in visual
recognition

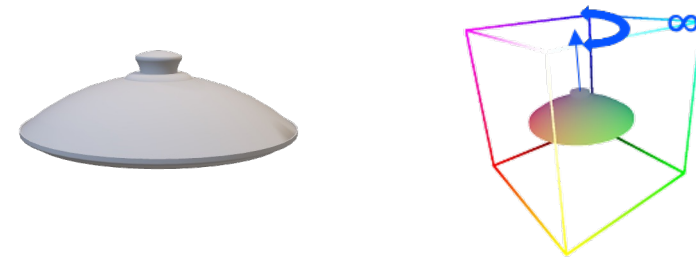
Similar actionability

Generalizable in
manipulation

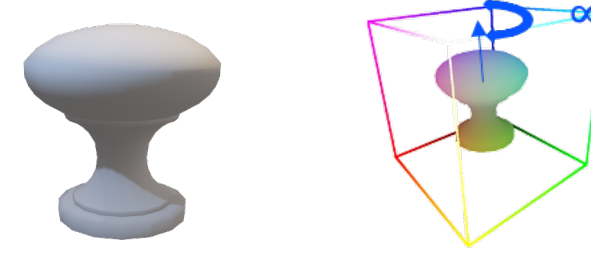
Generalizable

Actionable

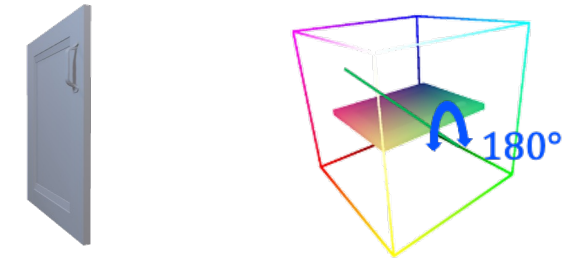
=> **GA**PartNet



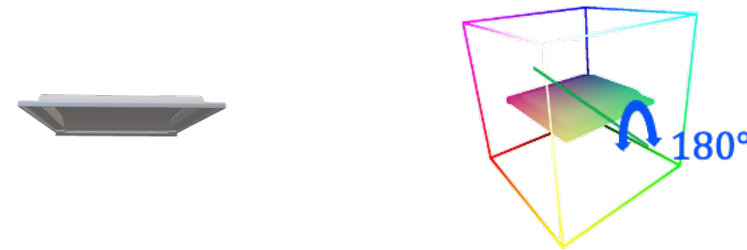
Slider Lid



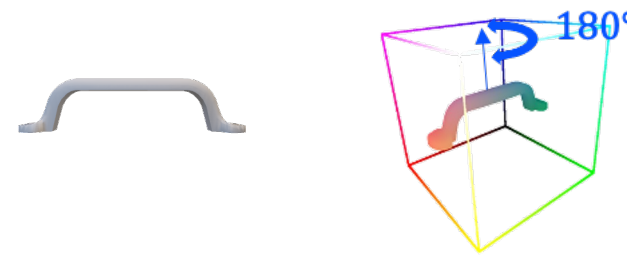
Round Fixed Handle



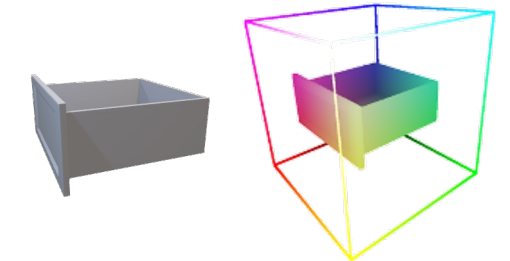
Hinge Door



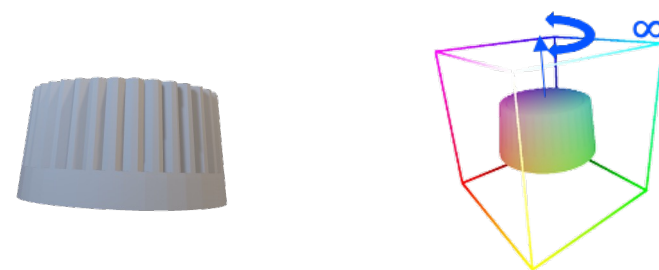
Hinge Lid



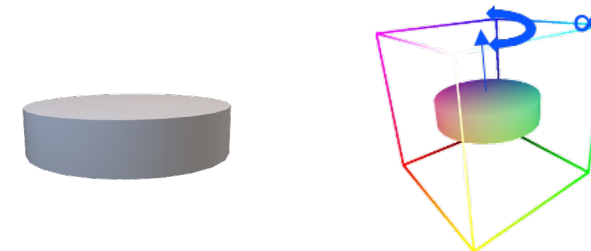
Line Fixed Handle



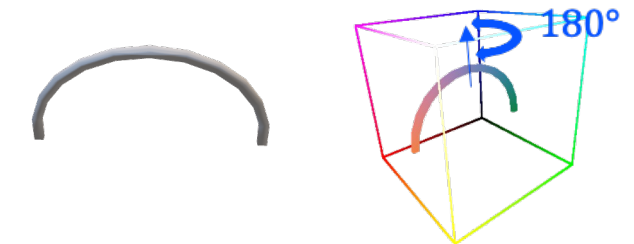
Slider Drawer



Hinge Knob



Slider Button



Hinge Handle

**Generalizable and Actionable Part
(GAPart)**

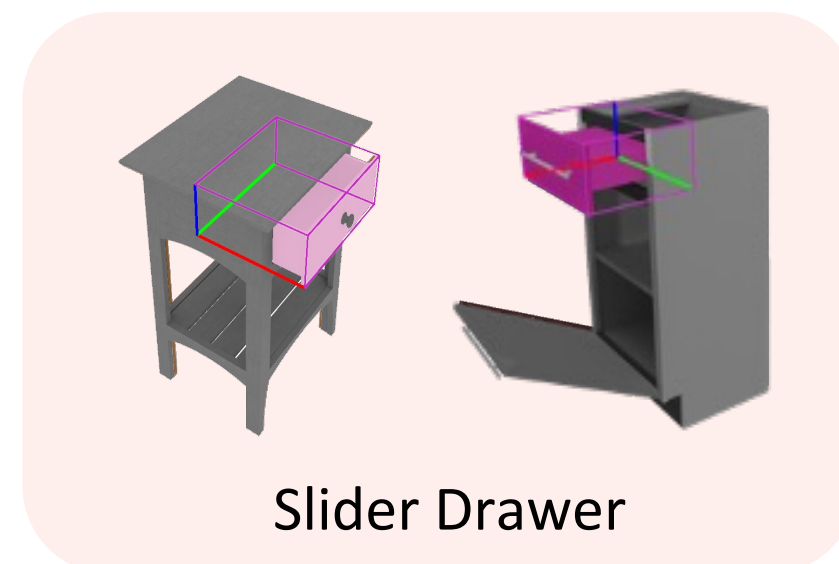
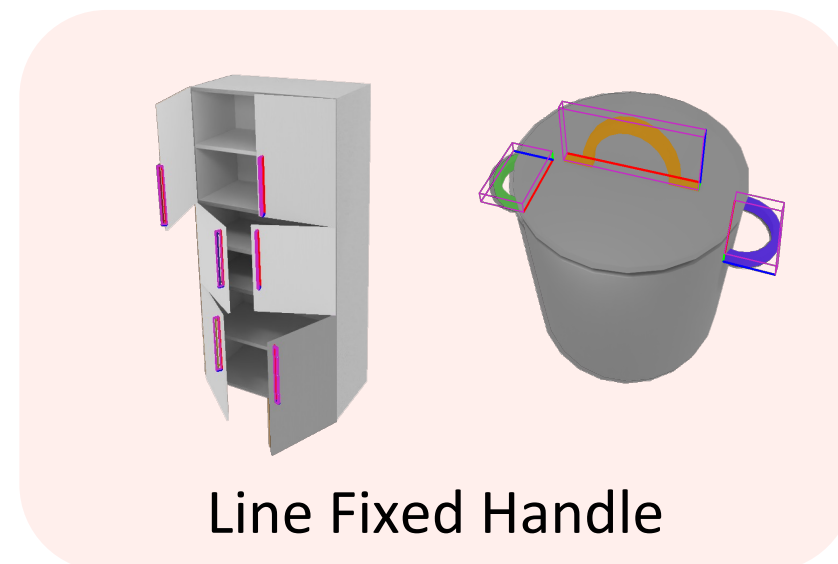
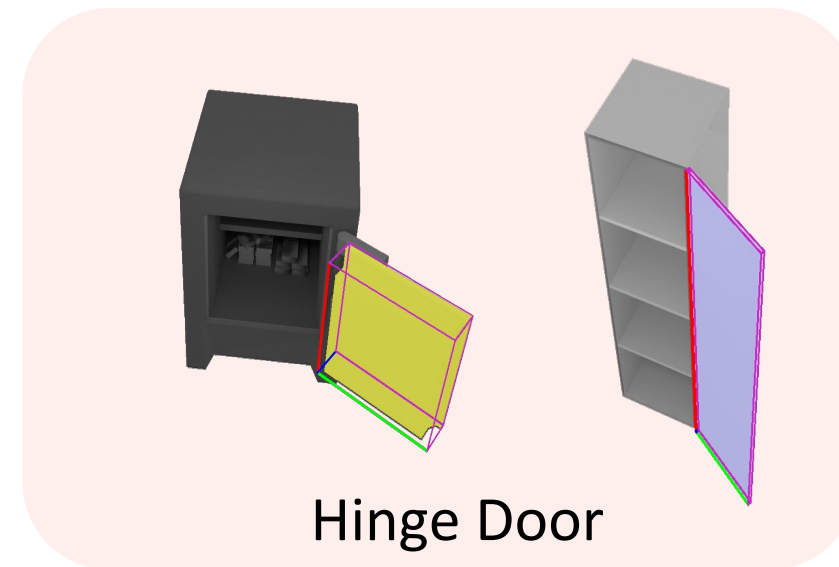
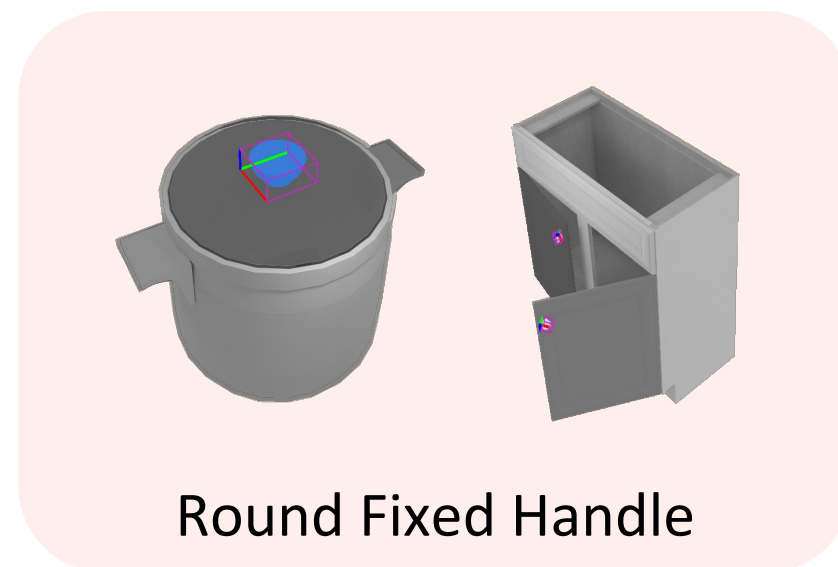
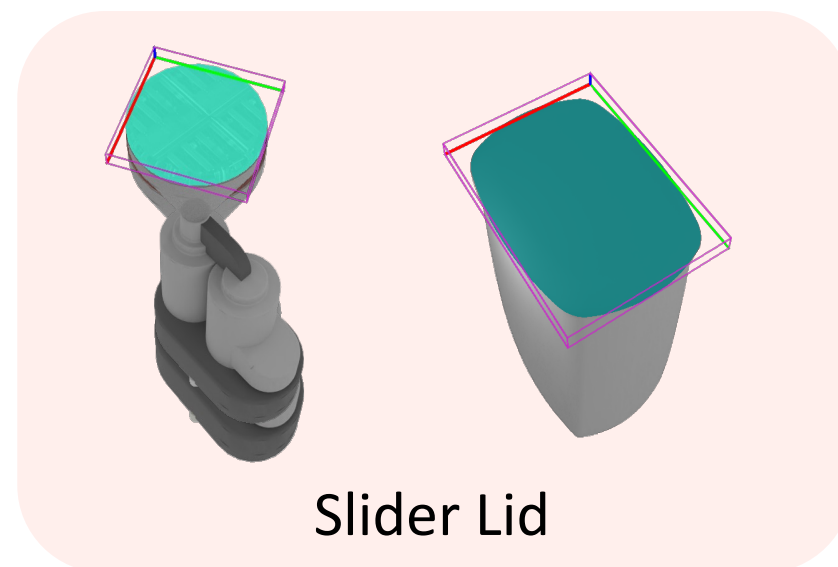
GAPartNet

Part-Centric

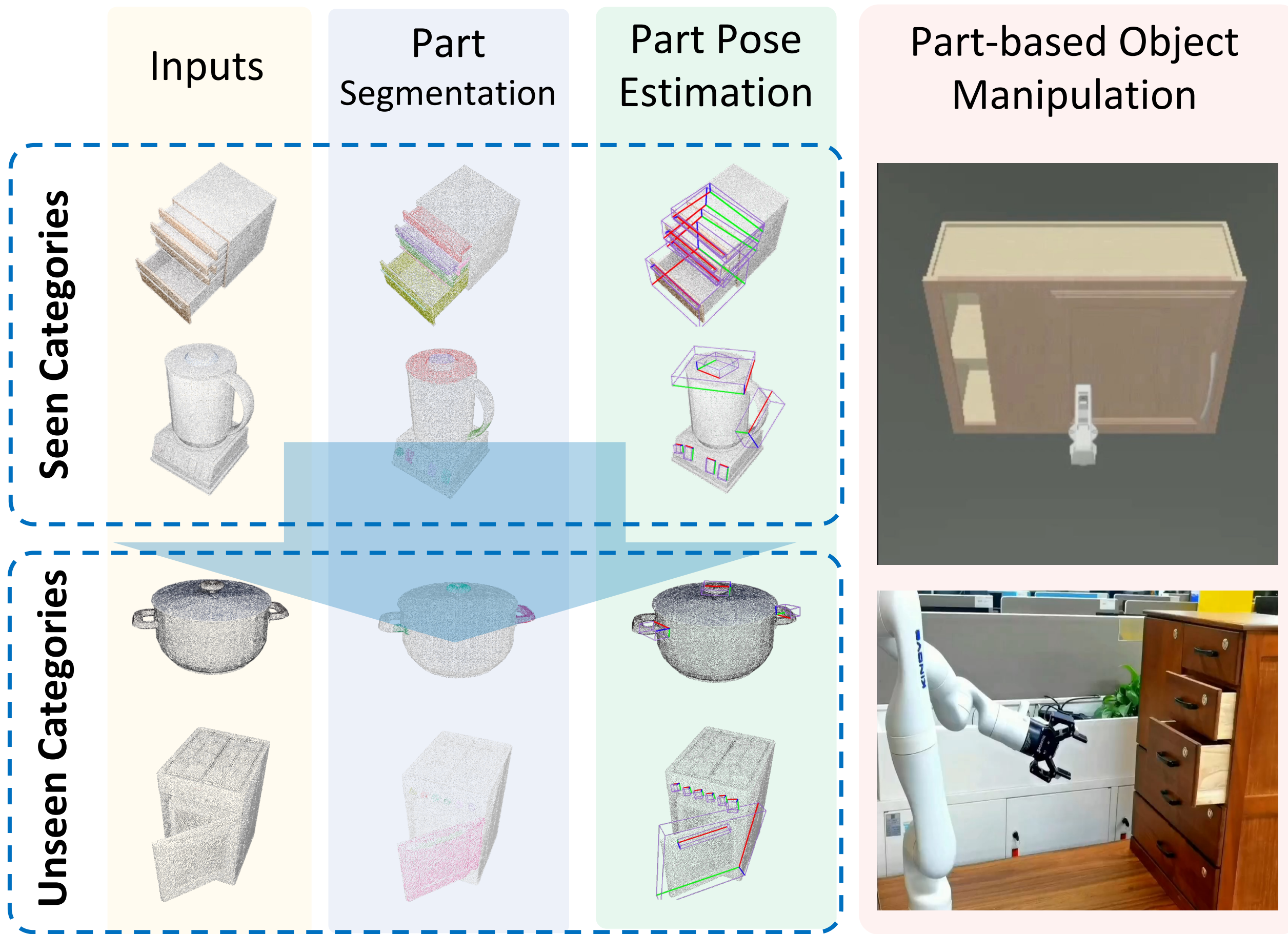
9 part classes
8489 parts

from

1166 objects
27 categories



GAPartNet



Cross-Category Tasks

Tasks and Methods

Cross-Category Tasks

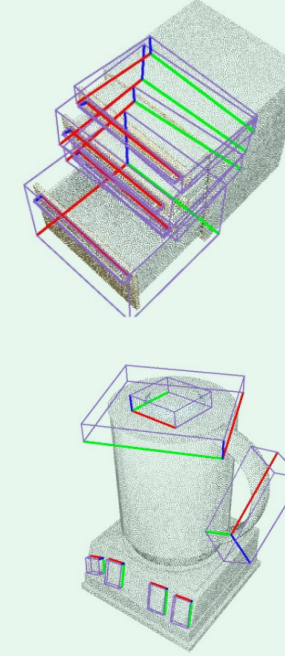
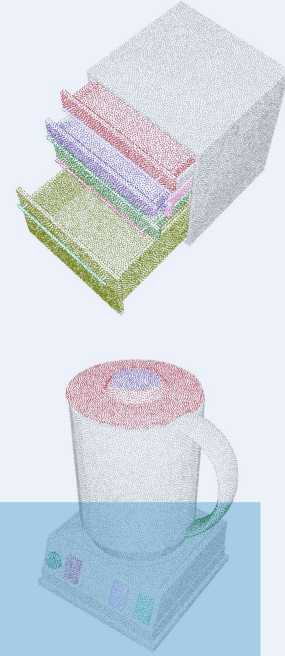
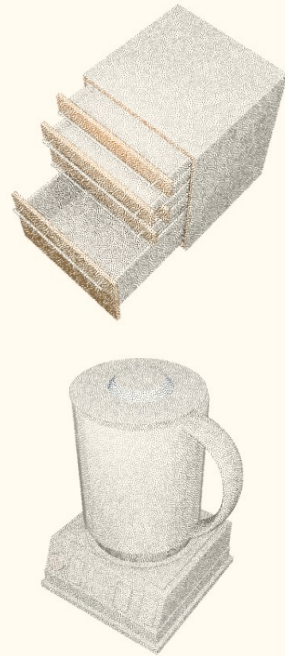
Inputs

Part
Segmentation

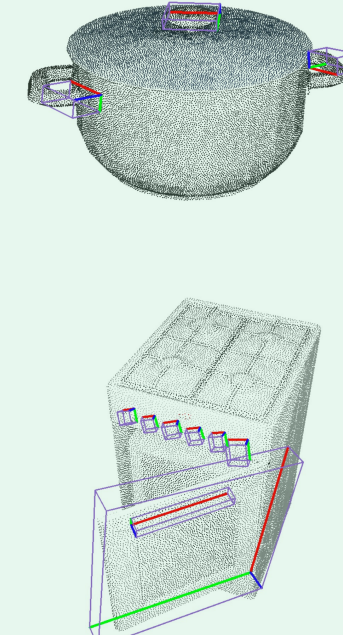
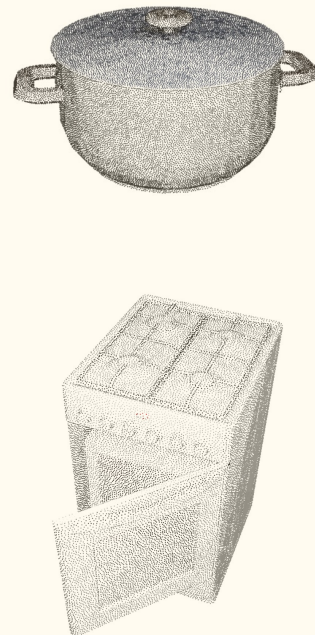
Part Pose
Estimation

Part-based Object
Manipulation

Seen Categories

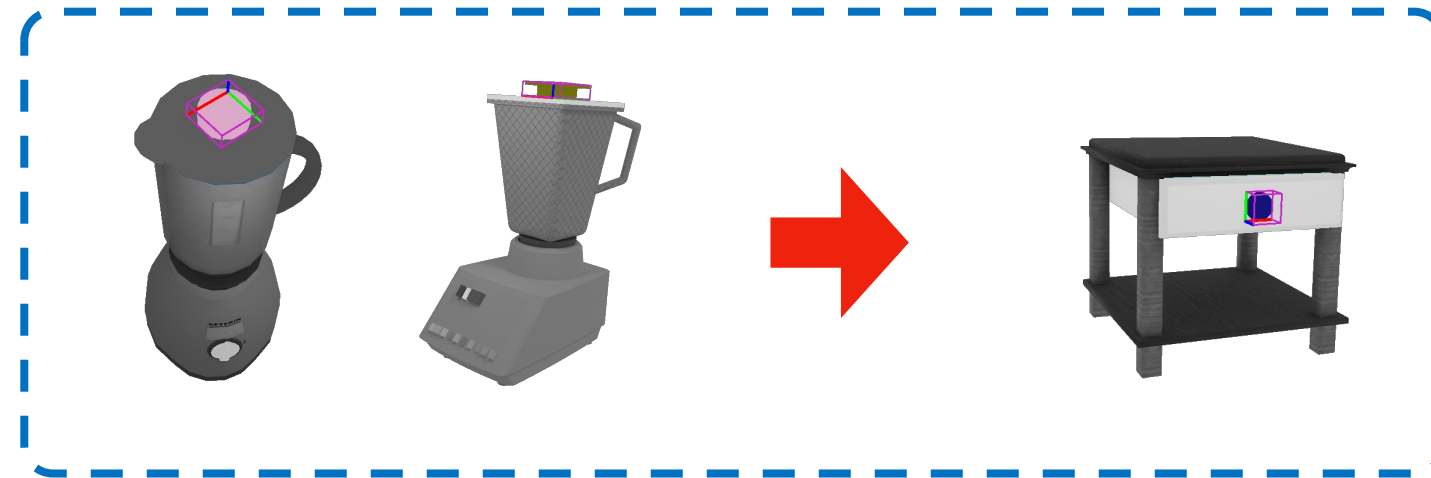


Unseen Categories



Task Challenges

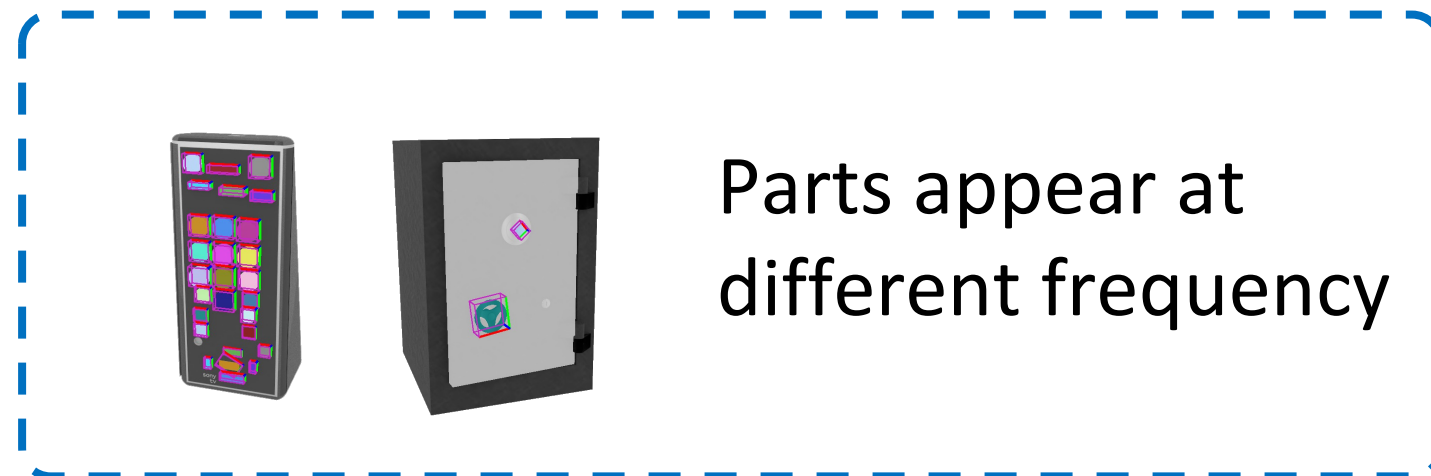
1. Huge part context variations.



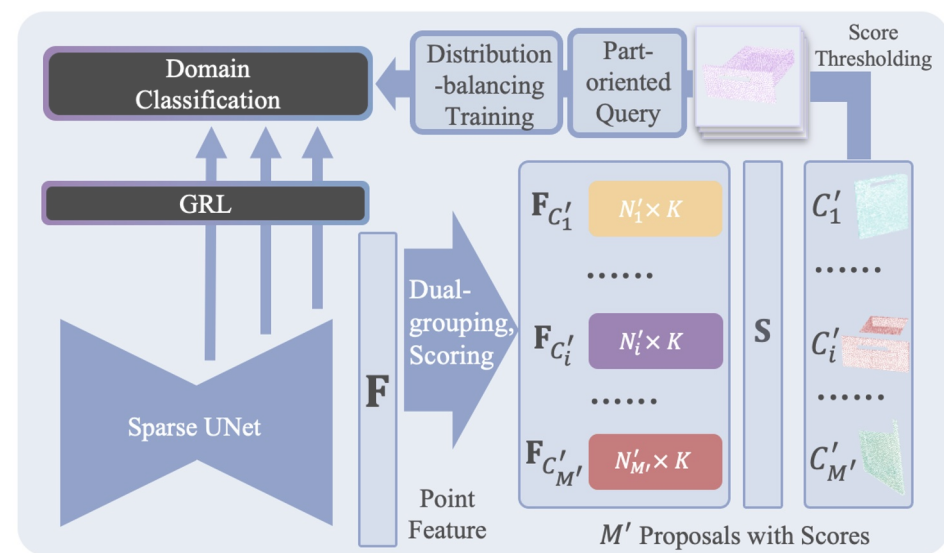
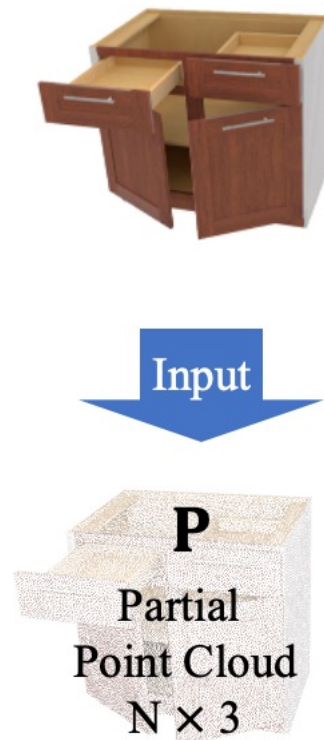
2. Huge part size variations.



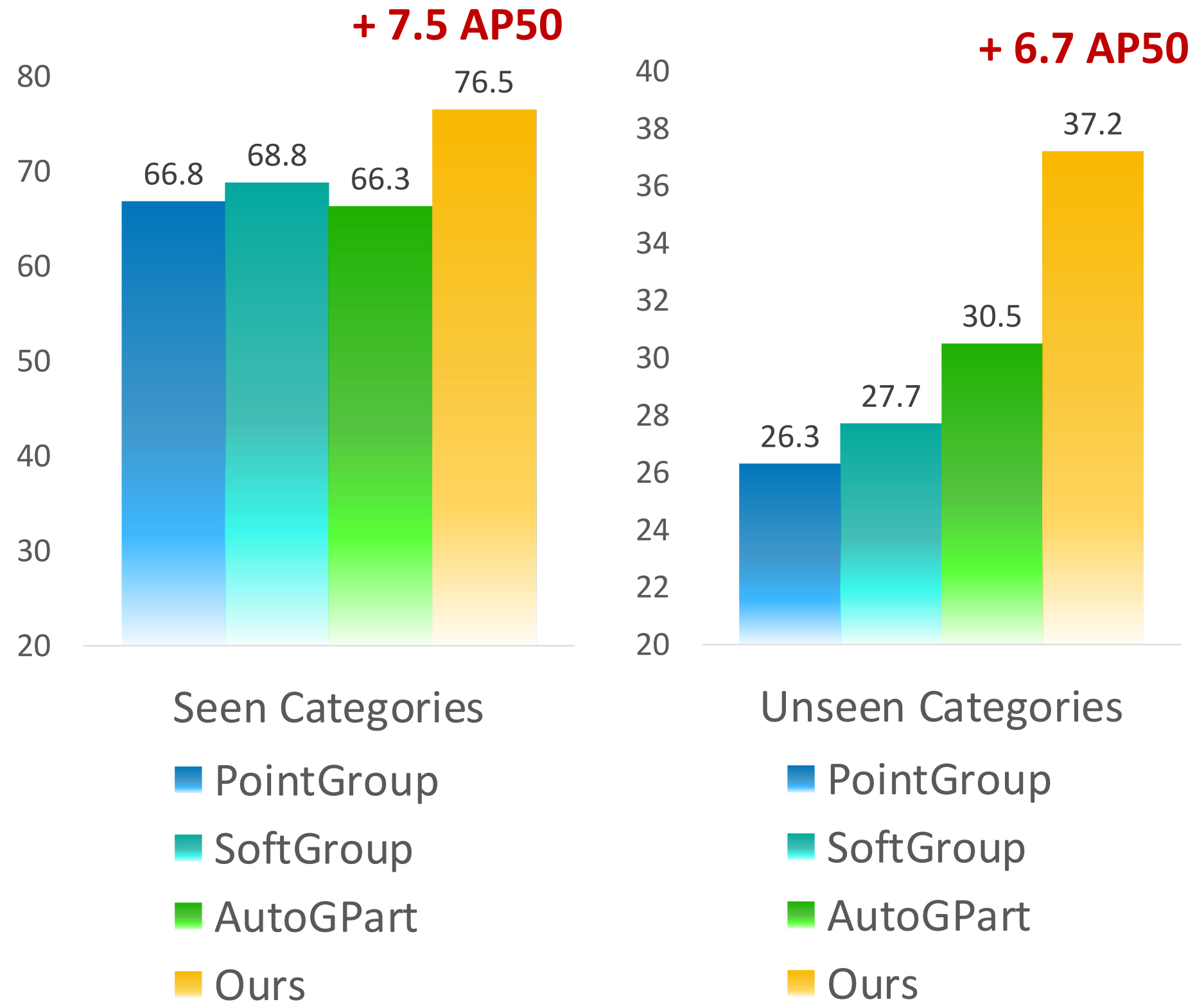
3. Imbalanced part distribution.



Domain-Generalizable Part Segmentation



Part Segmentation Results (AP50)



Perception Results

Cross-Category Part Segmentation (Seen Categories)

Object

Point Cloud

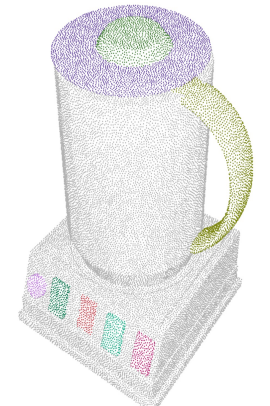
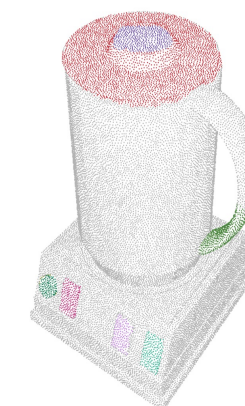
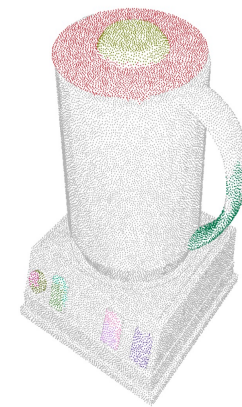
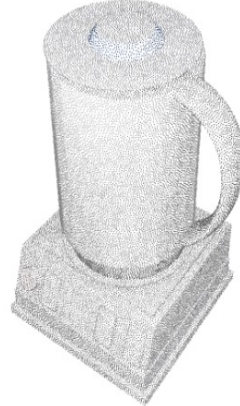
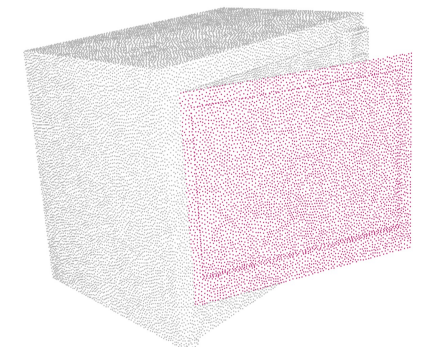
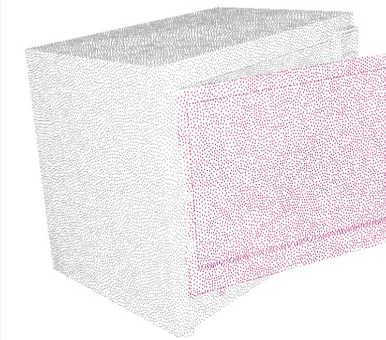
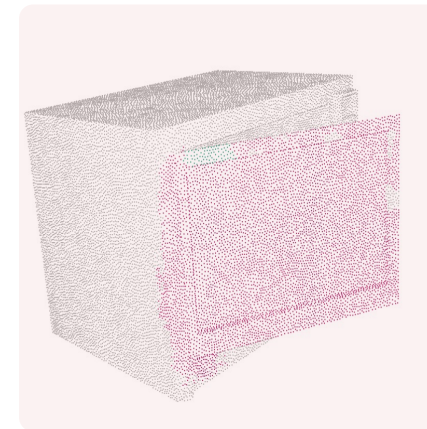
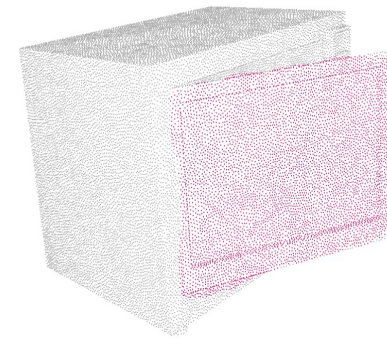
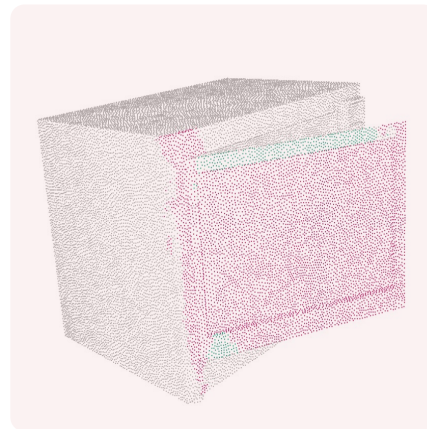
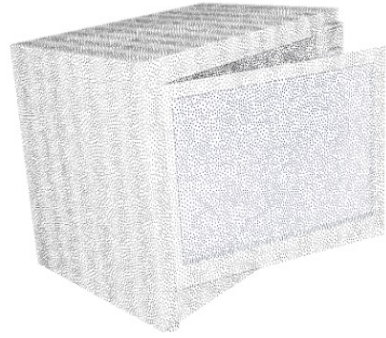
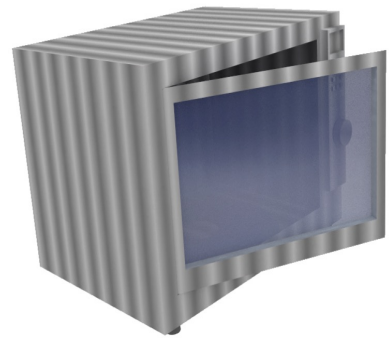
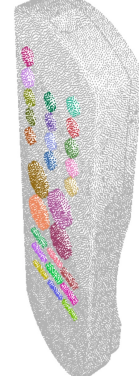
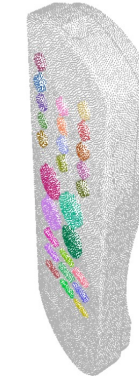
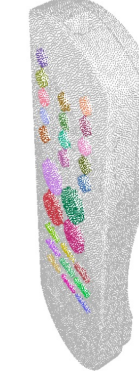
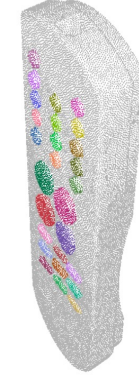
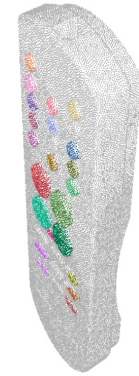
PointGroup

SoftGroup

AutoGPart

Ours

GT



Cross-Category Part Segmentation (Unseen Categories)

Object

Point Cloud

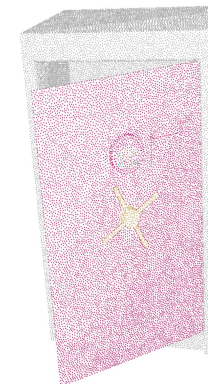
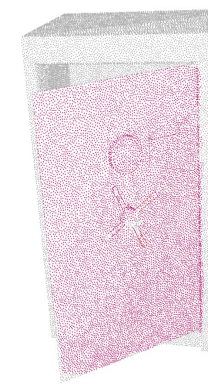
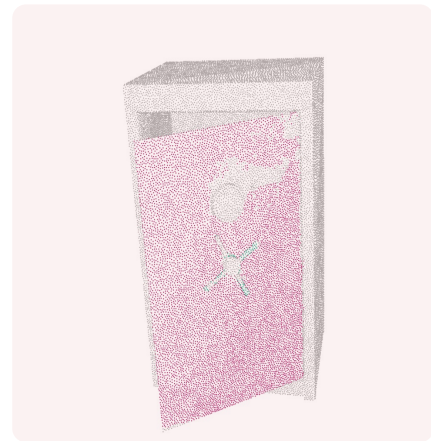
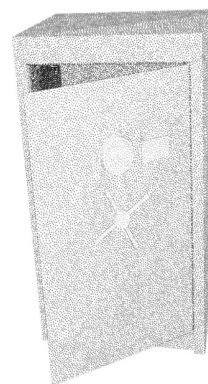
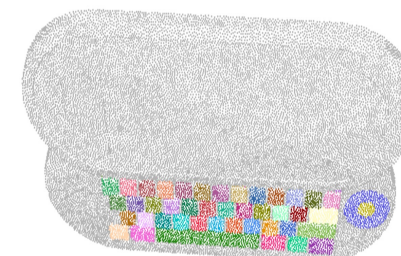
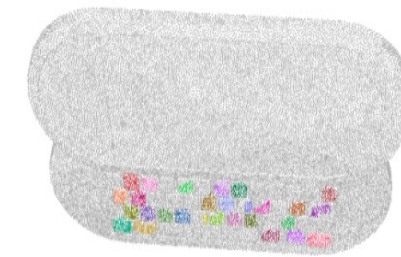
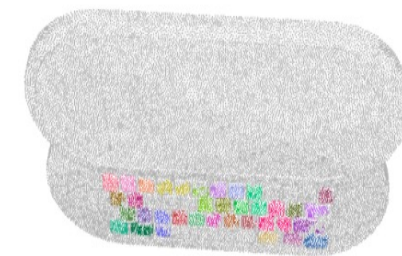
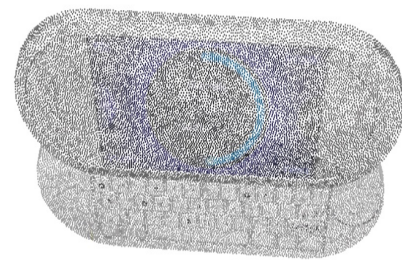
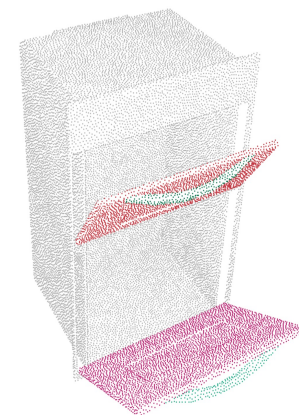
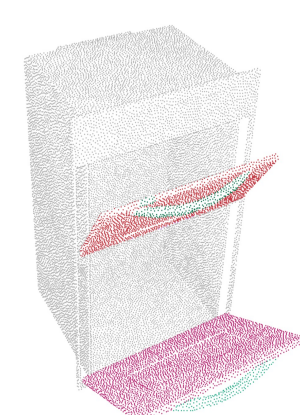
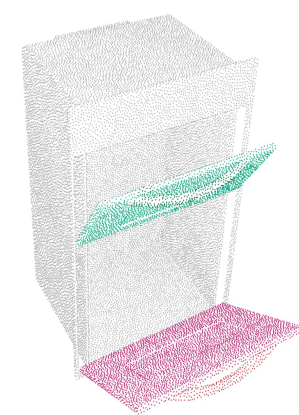
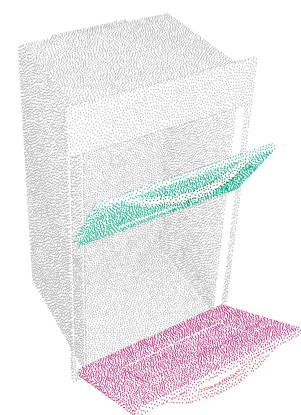
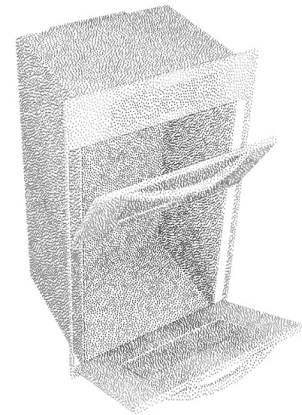
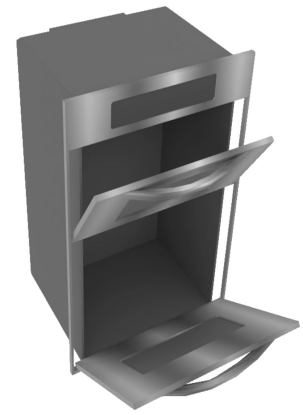
PointGroup

SoftGroup

AutoGPart

Ours

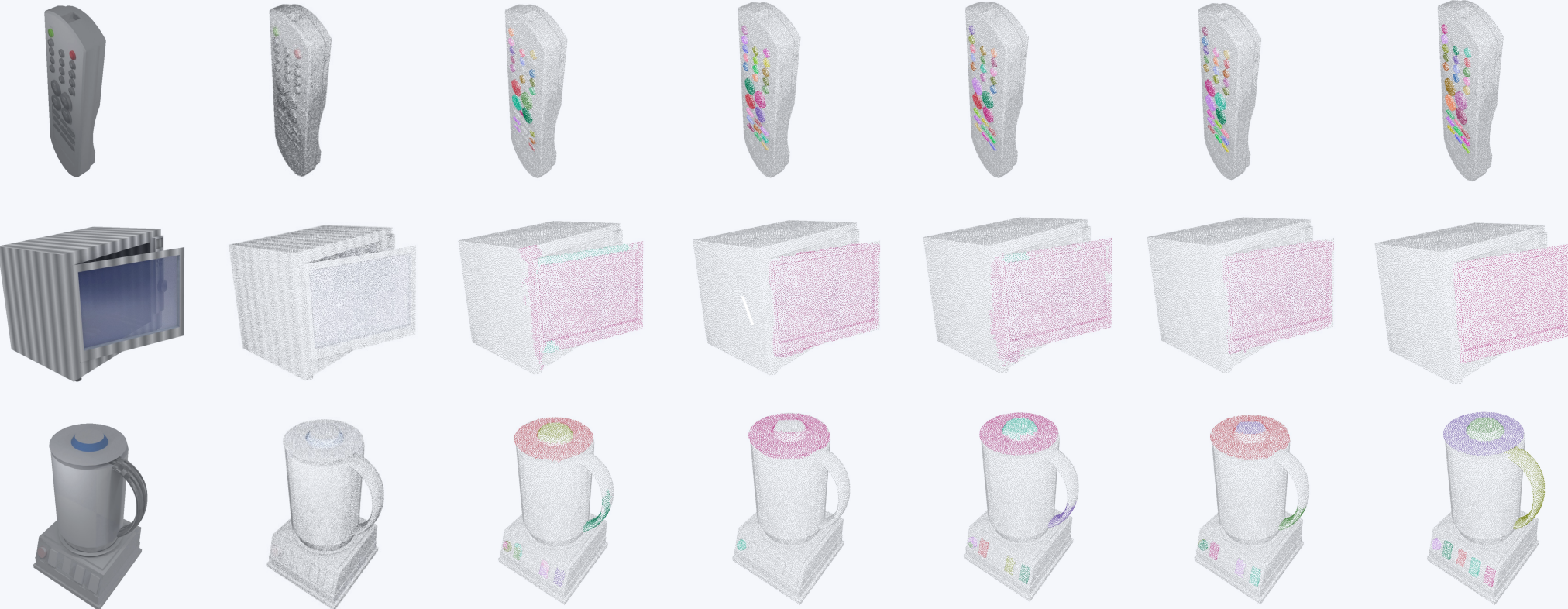
GT



Cross-Category Part Segmentation

Object Point Cloud PointGroup SoftGroup AutoGPart Ours GT

Seen Categories



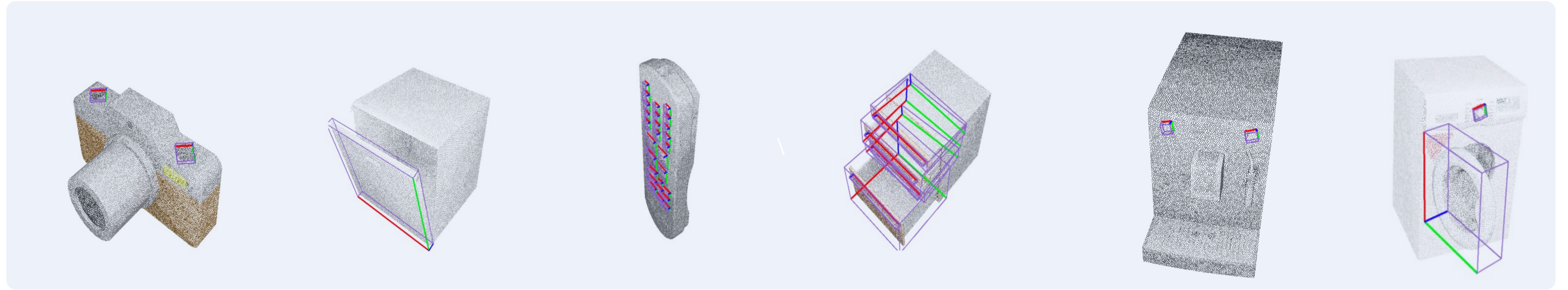
Unseen Categories



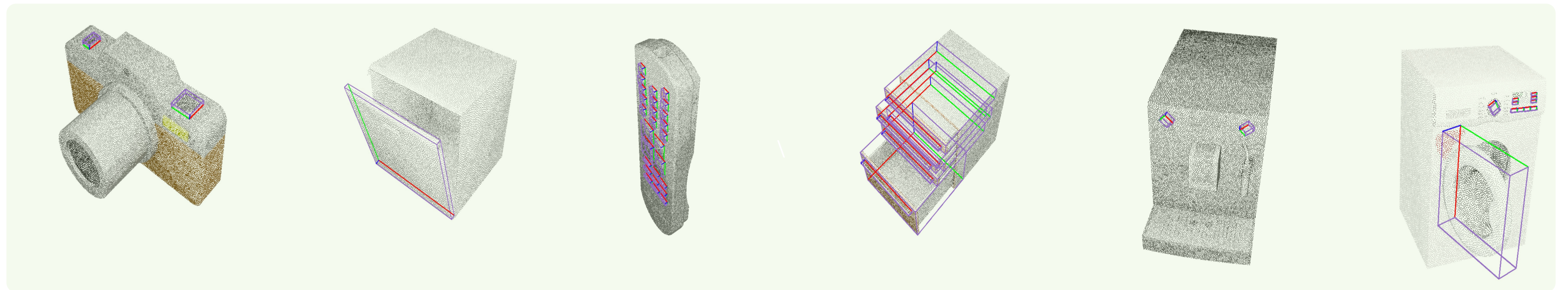
Cross-Category Part Pose Estimation

Seen Categories

Prediction

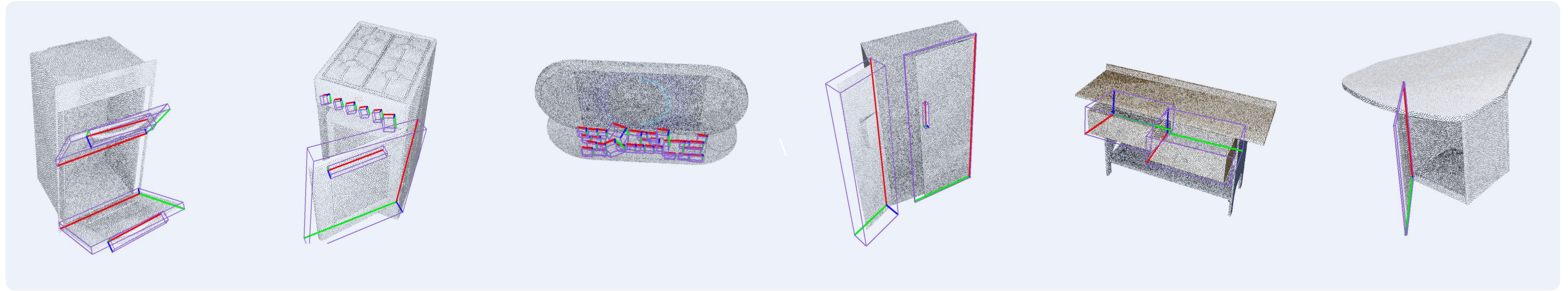


GT

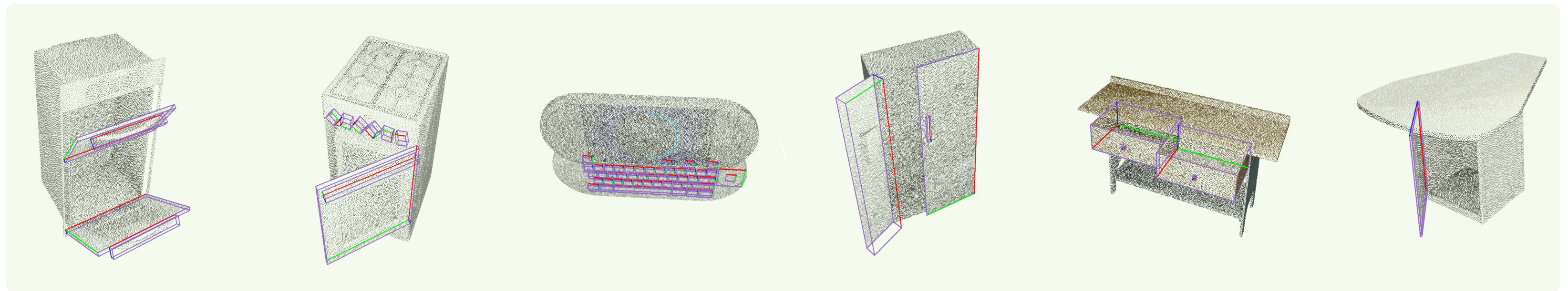


Cross-Category Part Pose Estimation Unseen Categories

Prediction



GT

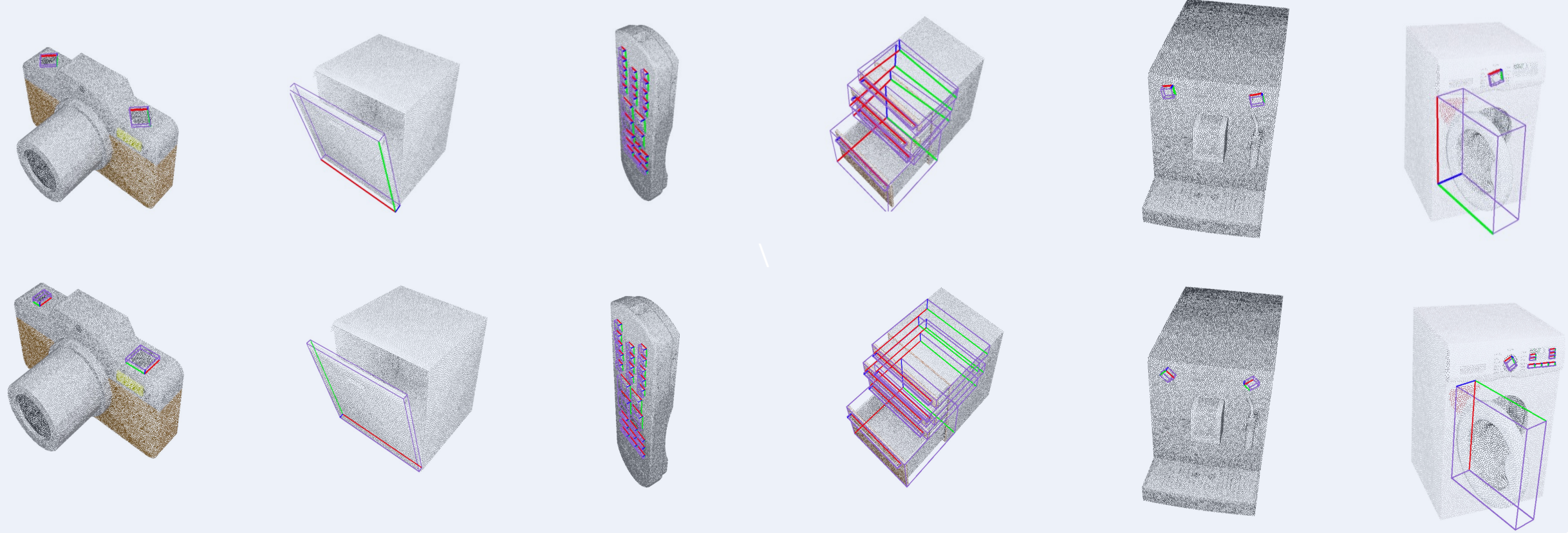


Cross-Category Part Pose Estimation

Seen Categories

Prediction

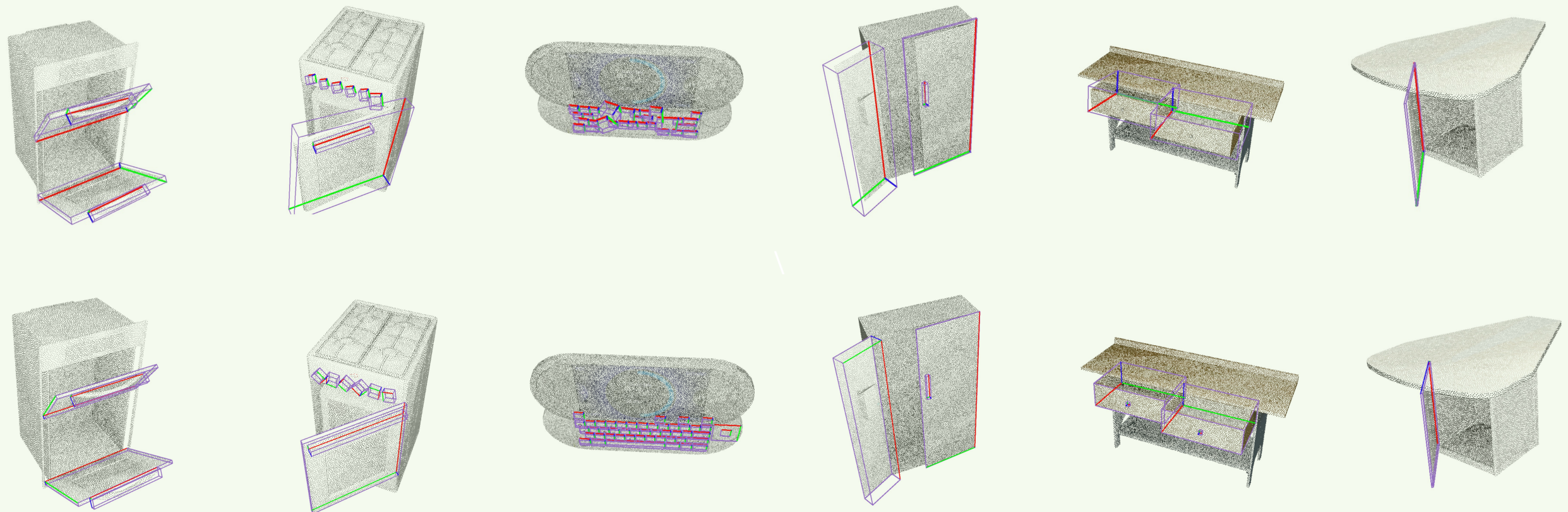
GT



Unseen Categories

Prediction

GT



Manipulation Experiments

Part-based Cross-category Object Manipulation

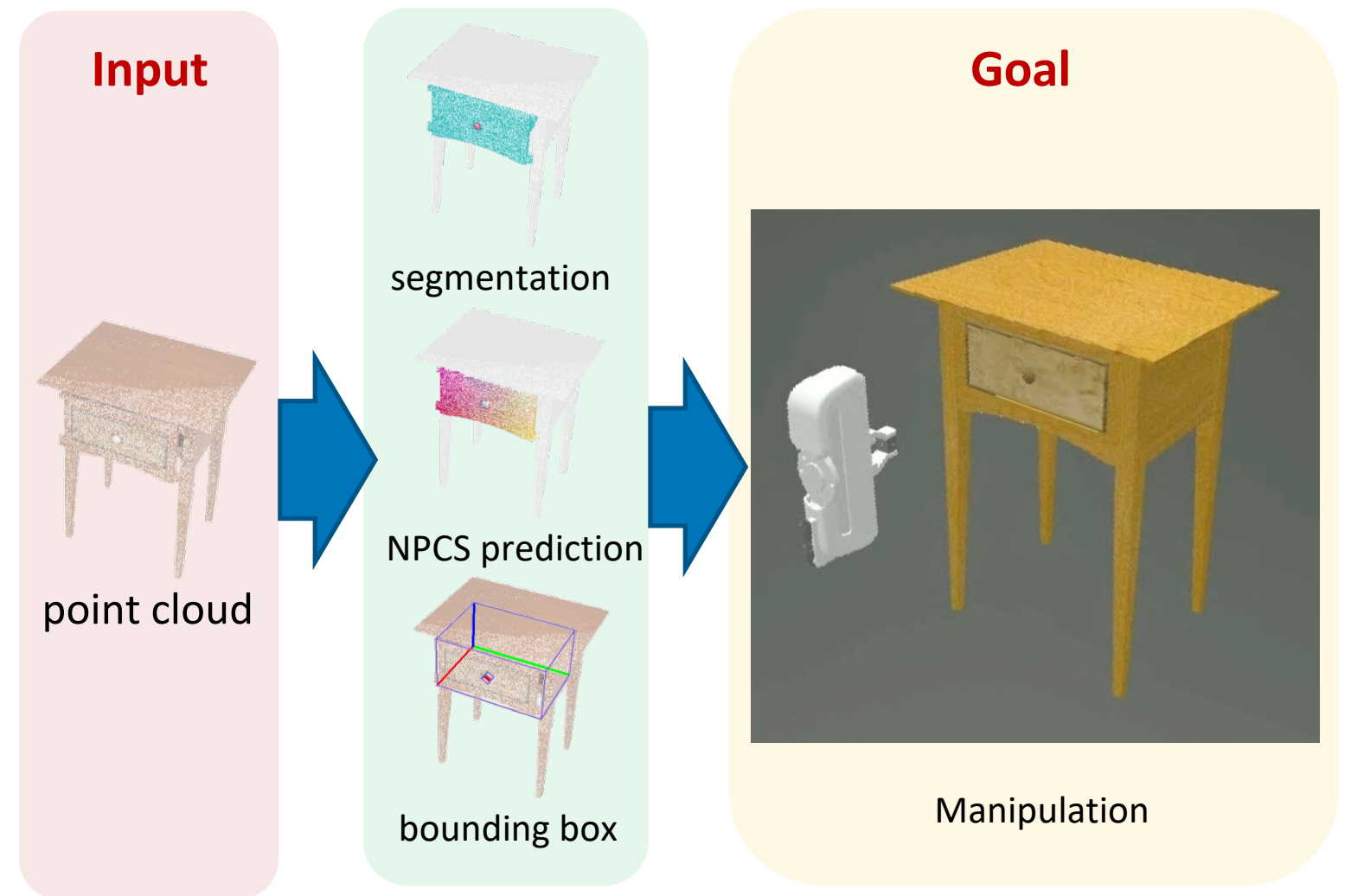


Drawer

Door

Handle

Button

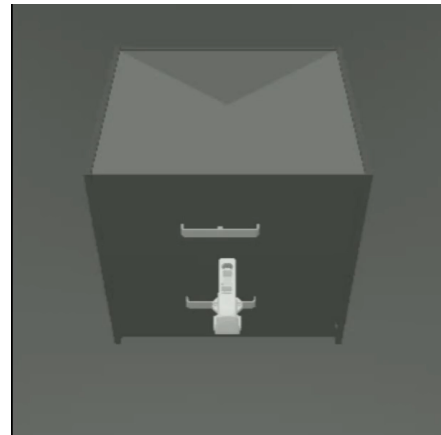


Visualization of Object Manipulation

Drawer

Door

Ours



ManiSkill



Real-World Experiment

Inputs



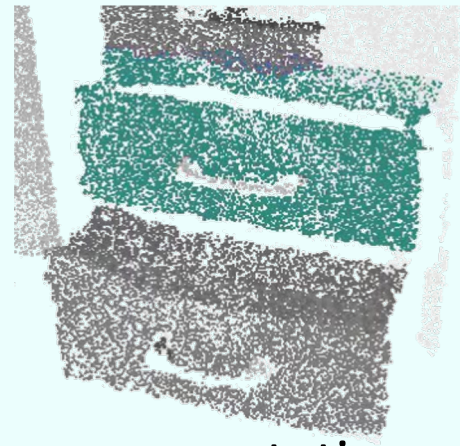
point cloud



RGB image



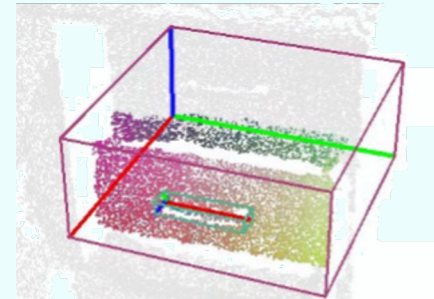
Predictions



segmentation



NPCS prediction



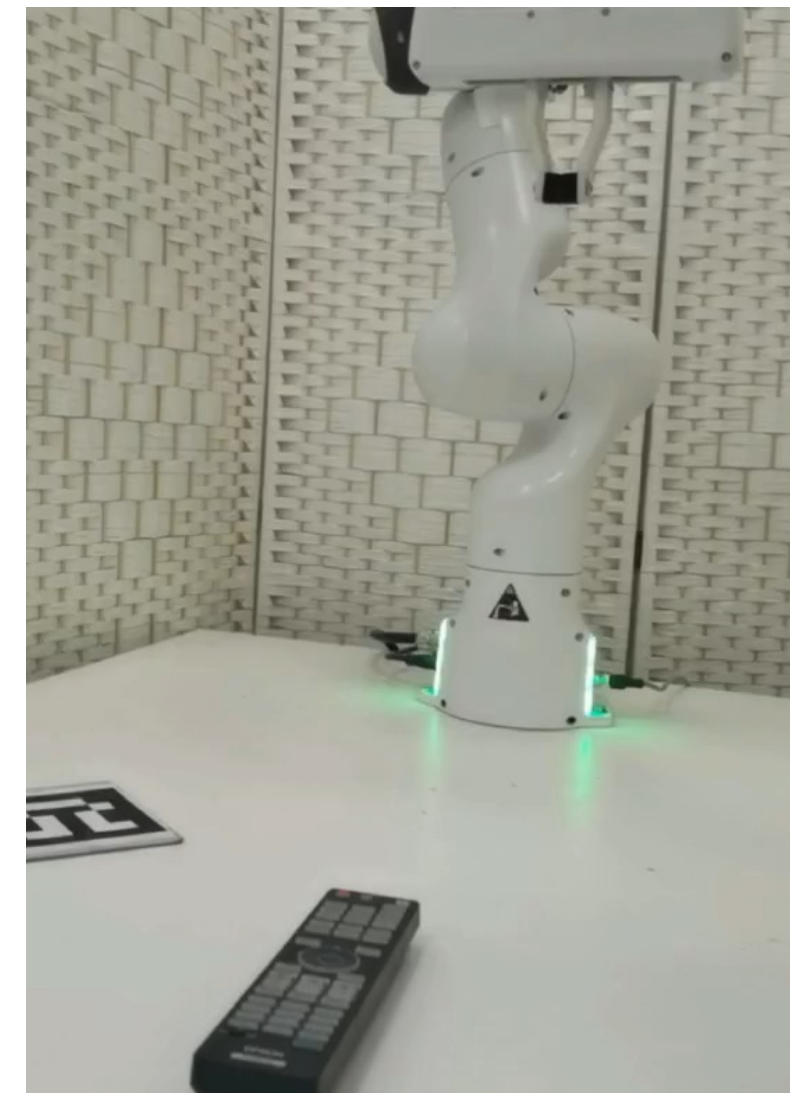
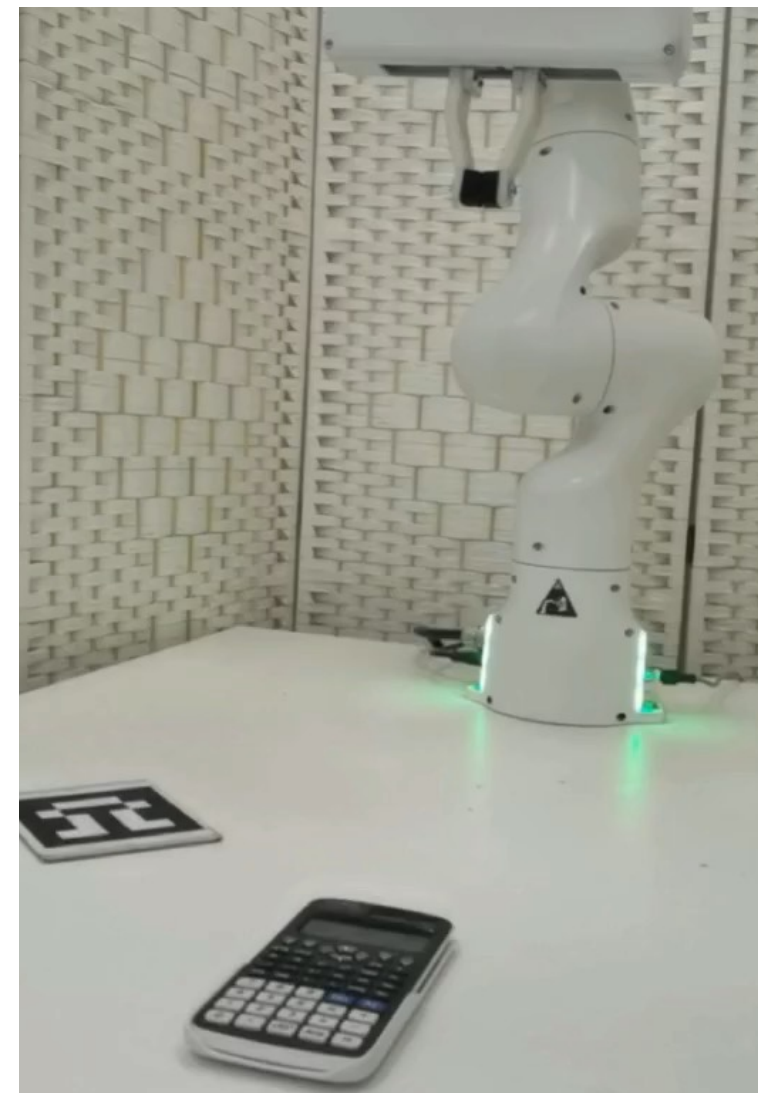
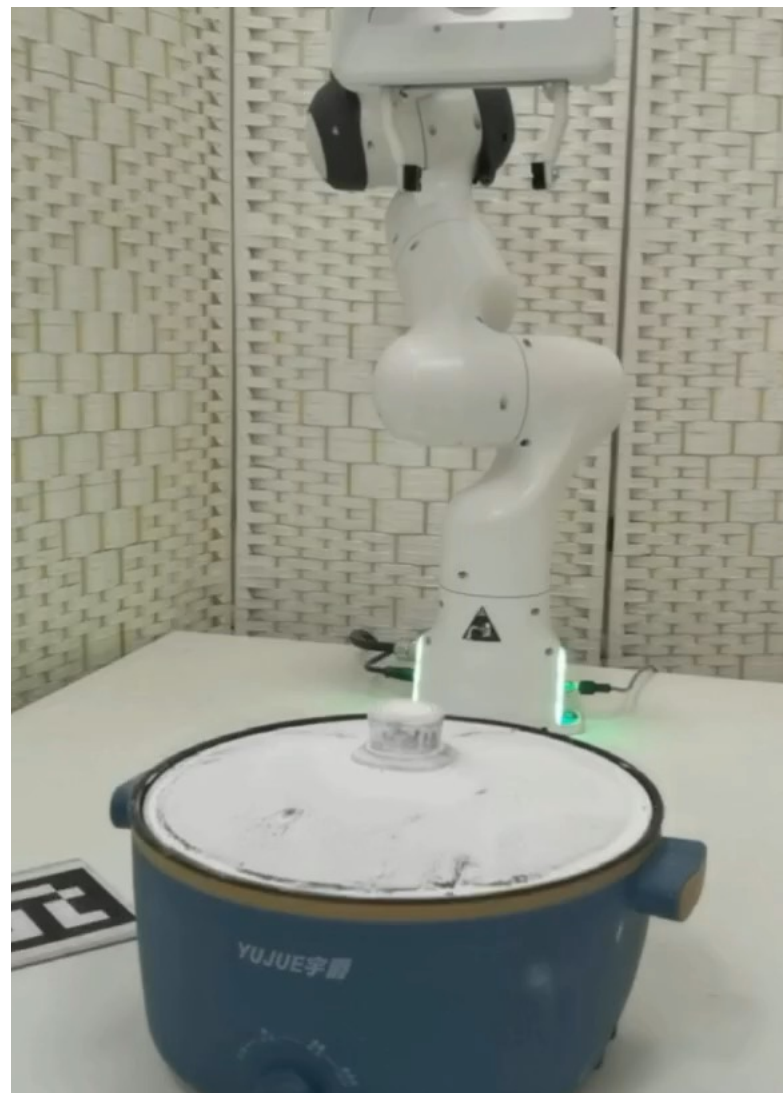
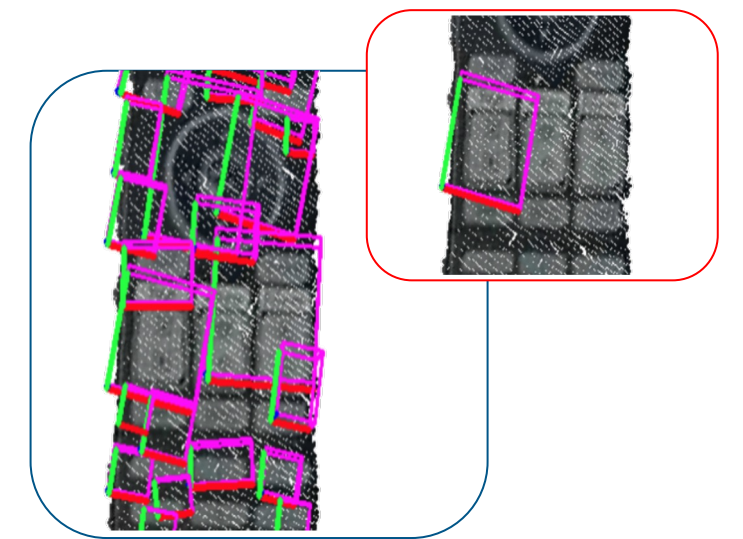
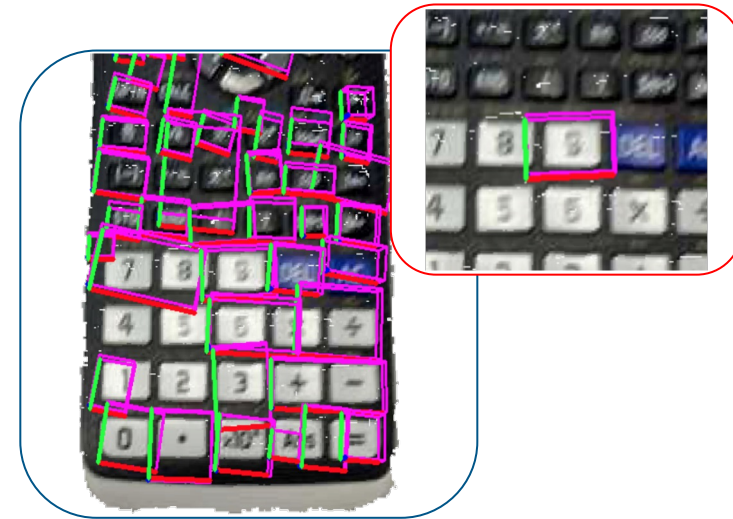
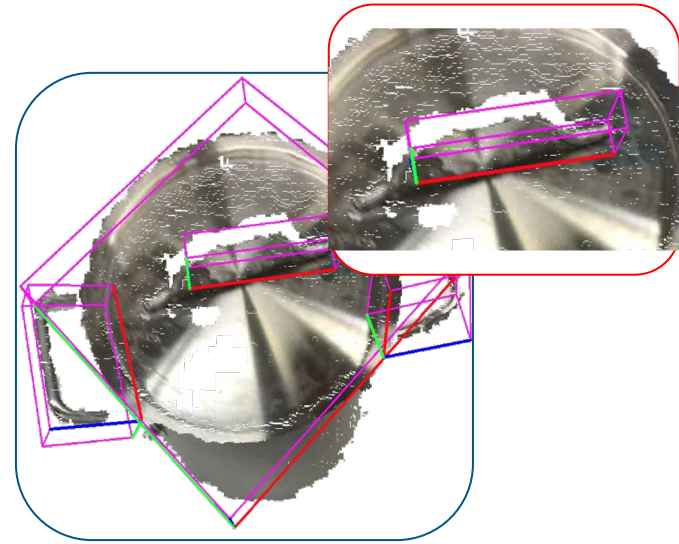
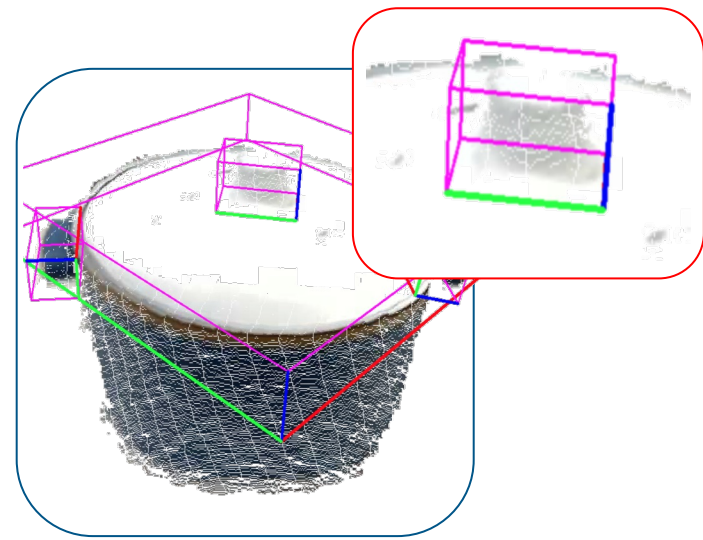
bounding box



Interaction Video







GAPartNet: Cross-Category Domain-Generalizable Object Perception and Manipulation via Generalizable and Actionable Parts

JUNE 18-22, 2023



CVPR2023 Highlight

Thank you !



QR code

