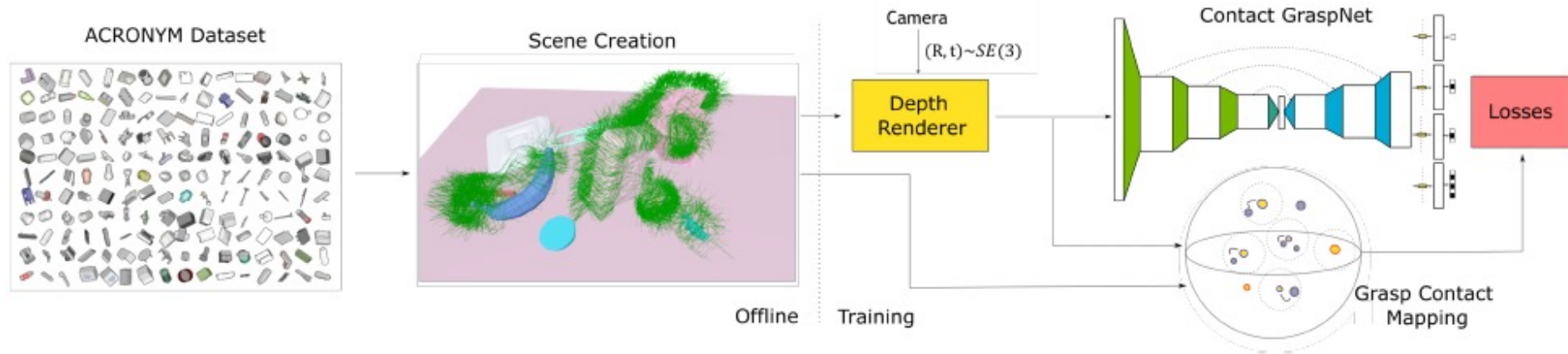

CS686: Presentation
Omnihang: Learning to Hang Arbitrary Objects

You and Lin et al.

Minjae Song
(송민재)

Contact-GraspNet (by Seokryun Choi)



- **Generate grasp pose from scene**
- **Grasp mapping with depth camera**
- **High success rate & robustness**

Background – Hanging object

Hanging objects is a common daily task

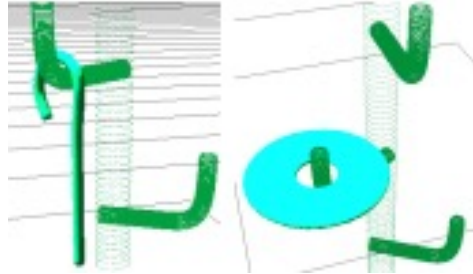


Background – Hanging task



- Where to hang
- How to hang

Related works



Learning to Place New Objects in a Scene.
Jiang et al., IJRR 2012



Deep Spatial Autoencoders for Visuomotor Learning.
Finn et al., ICRA 2016

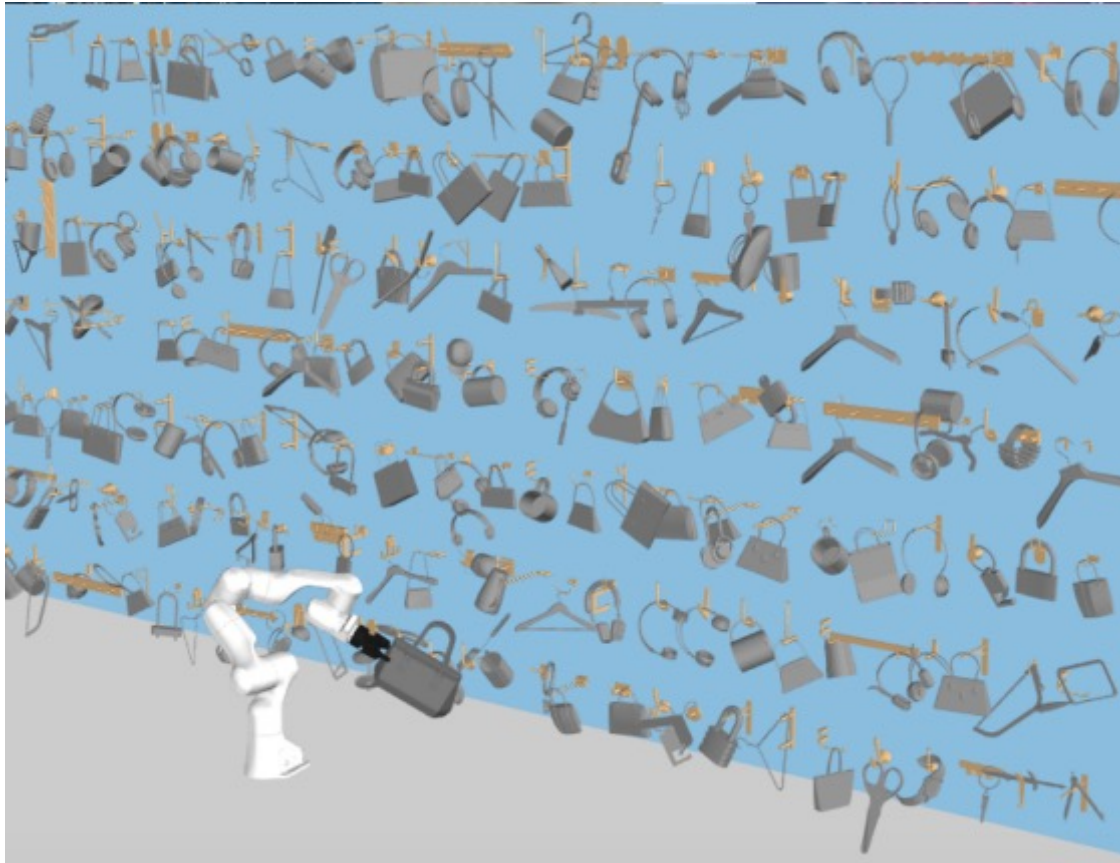


kPAM: KeyPoint Affordances for Category-Level
Robotic Manipulation Manueili et al., ISRR 2019



End-To-End Training of Deep Visuomotor Policies
Levine et al., JMLR 2016

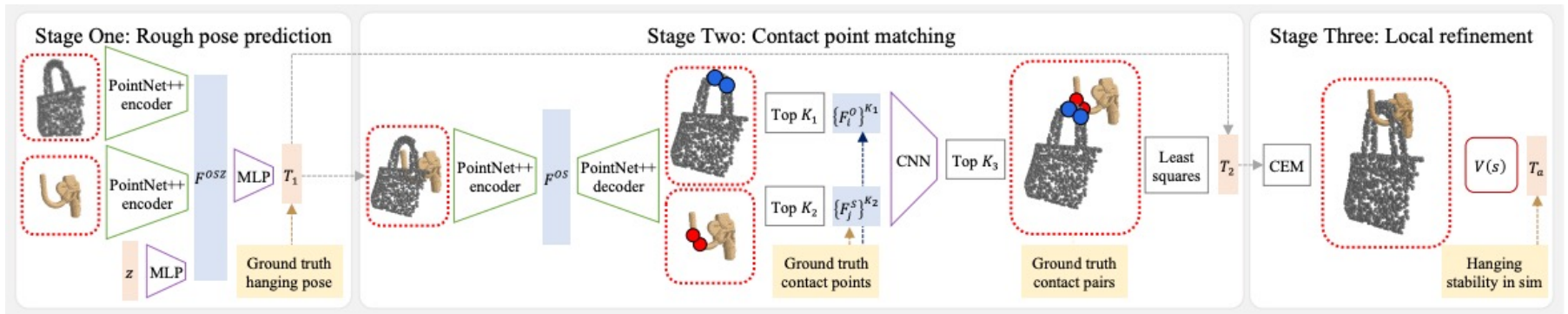
Problem



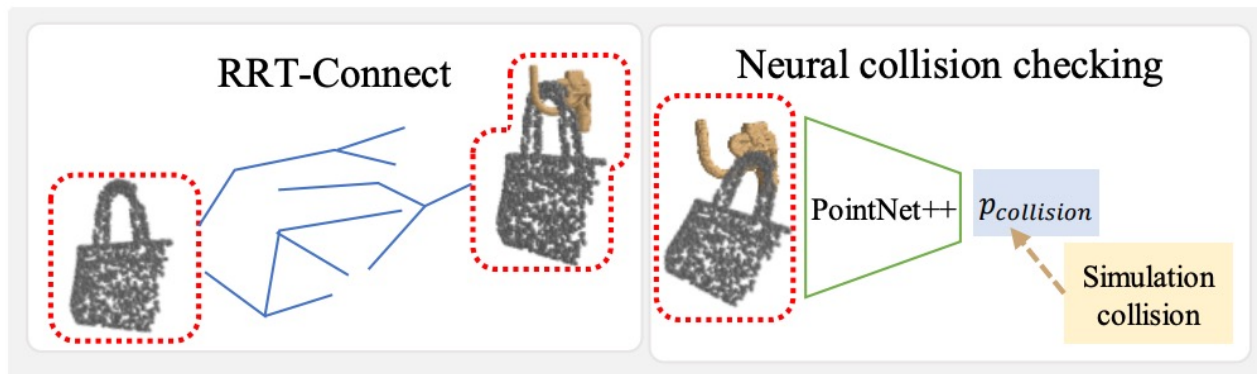
Hanging general objects to arbitrary supporting items

Overall framework

1. Where to hang



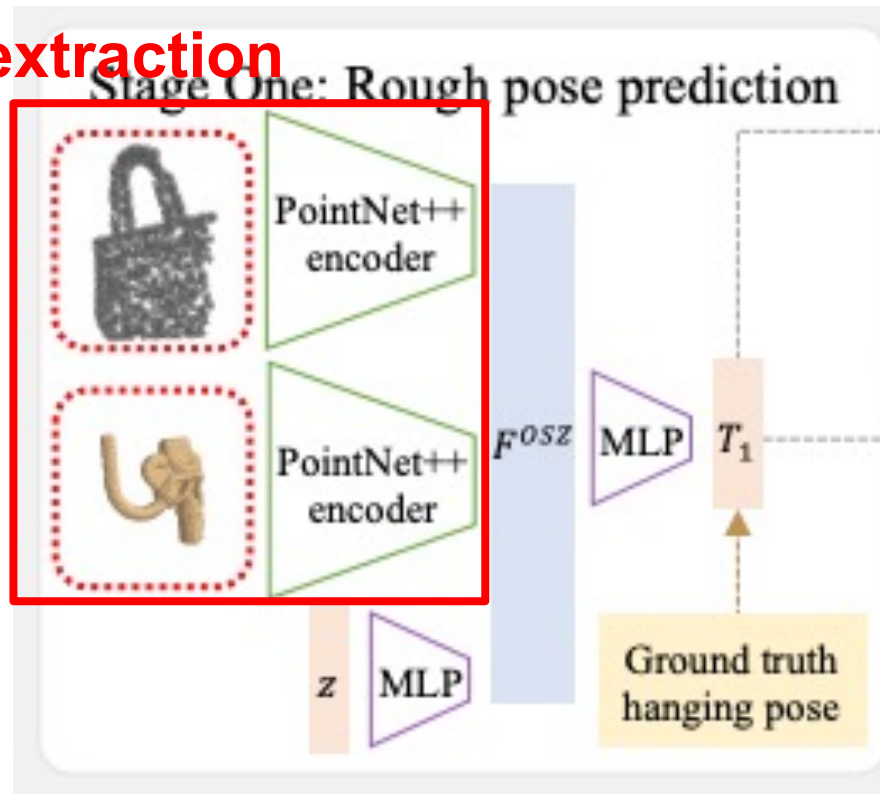
2. How to hang



1. Where to hang

Rough pose prediction

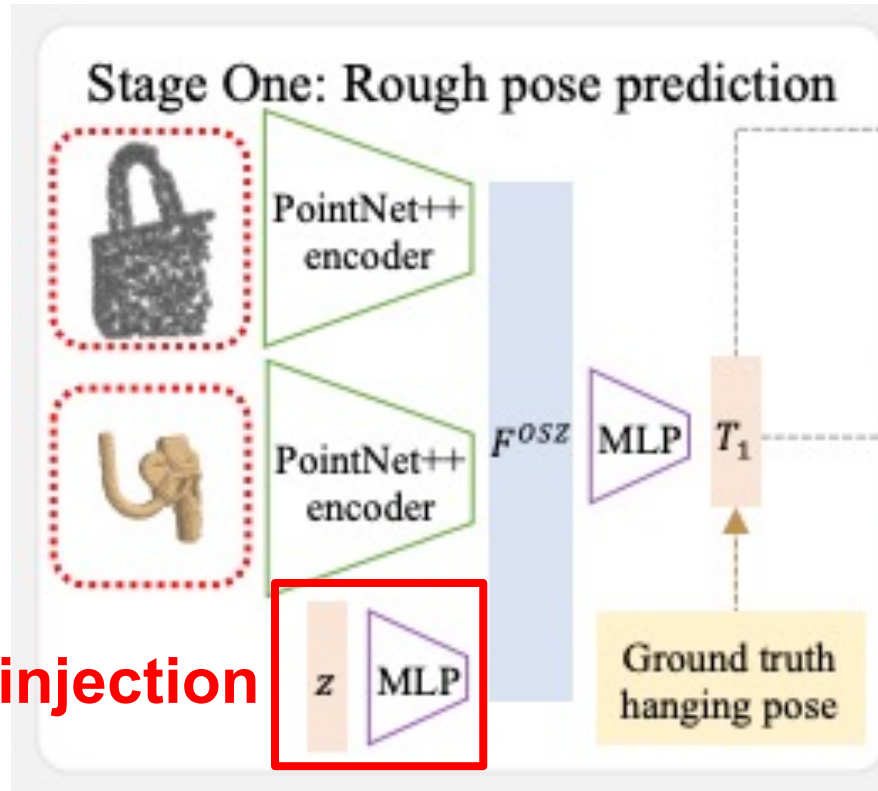
1. Feature extraction



Rough initial estimate of hanging pose

1. Where to hang

Rough pose prediction

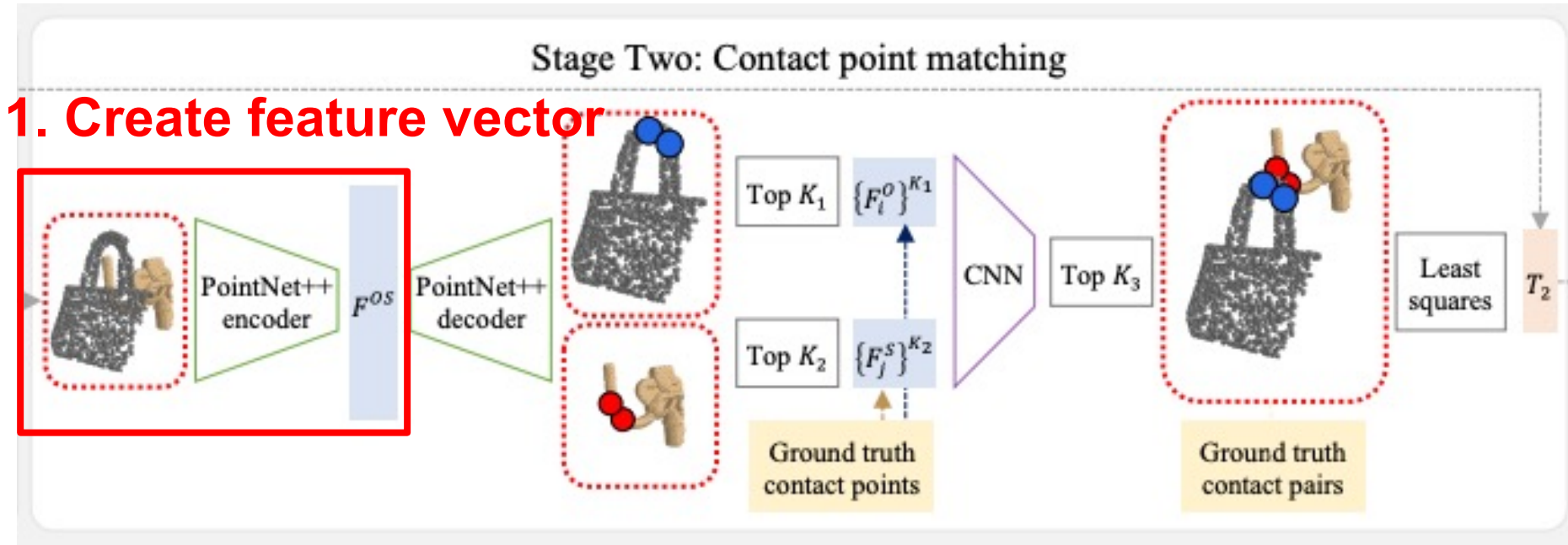


2. Noise injection

Exploration effect

1. Where to hang

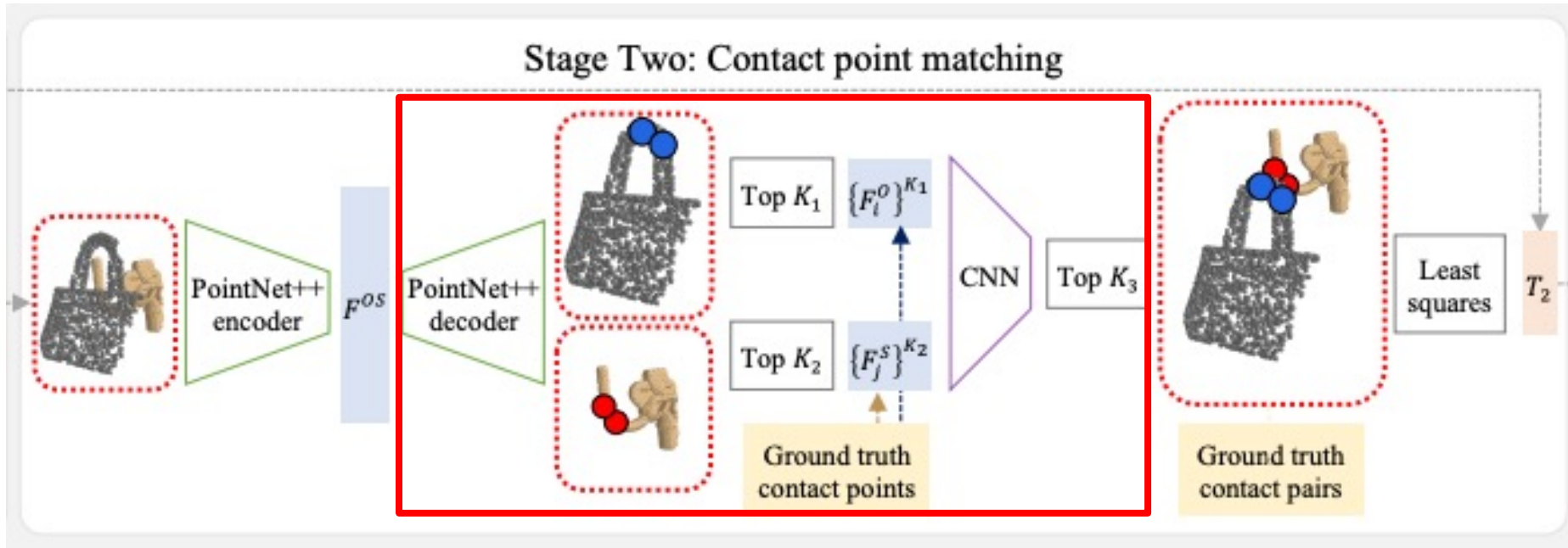
Contact point matching



Which point should be in contact

1. Where to hang

Contact point matching

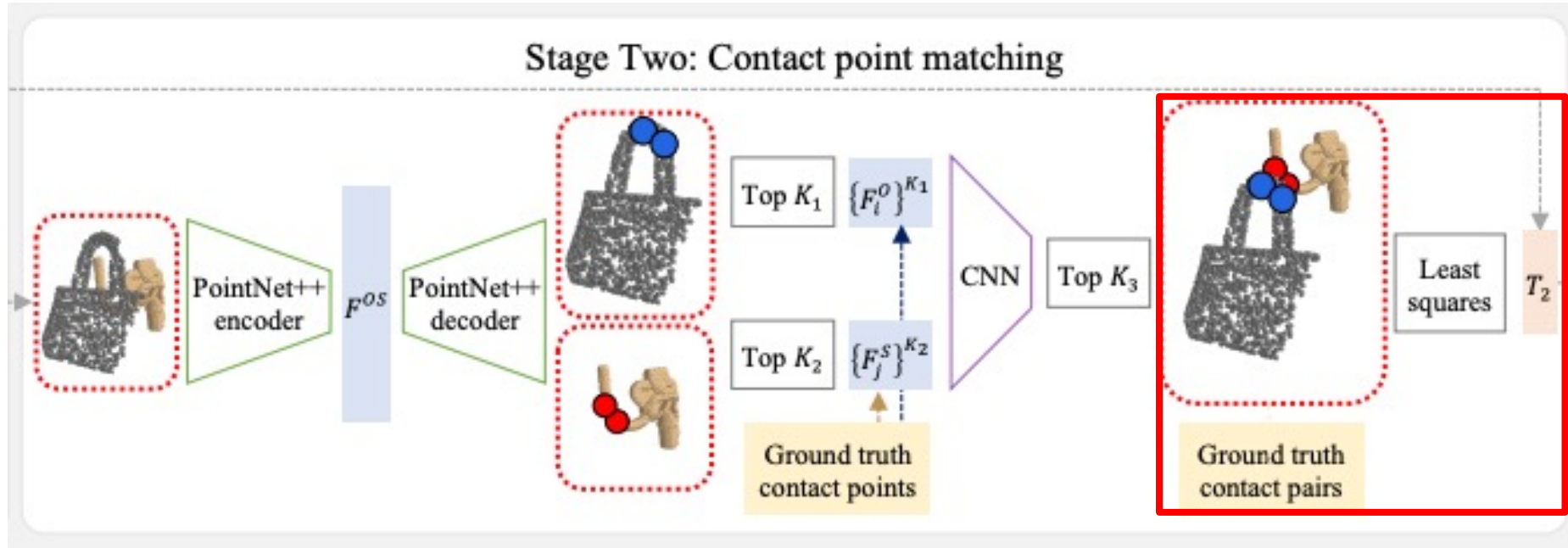


2. Correspondence for pair validation

- Selection wrt score module
- Binary classification problem
- Ranking loss

1. Where to hang

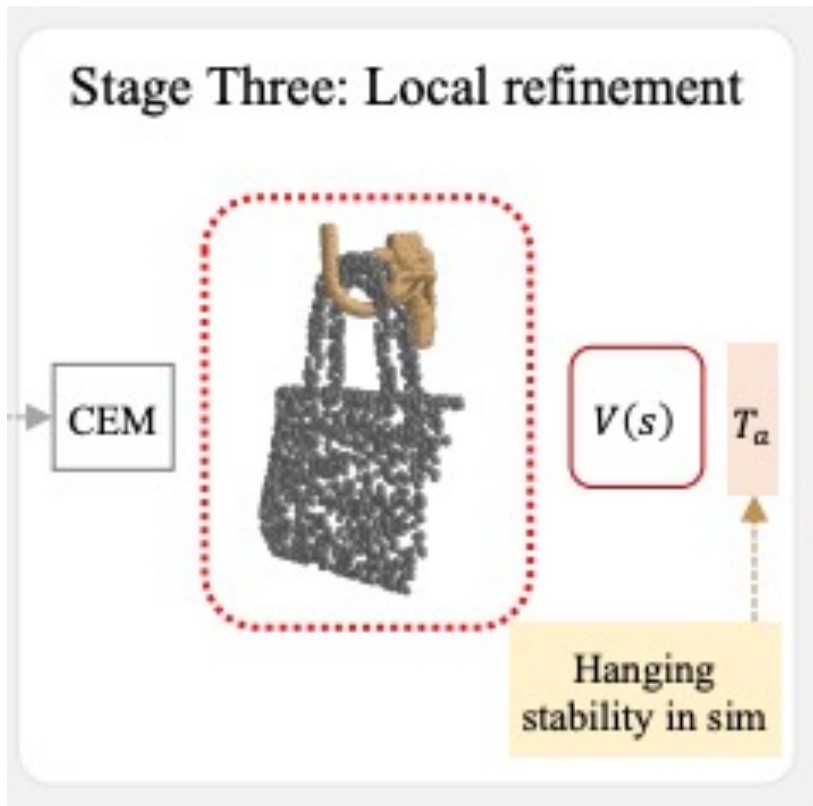
Contact point matching



3. Optimization for minimal distance

1. Where to hang

Local refinement



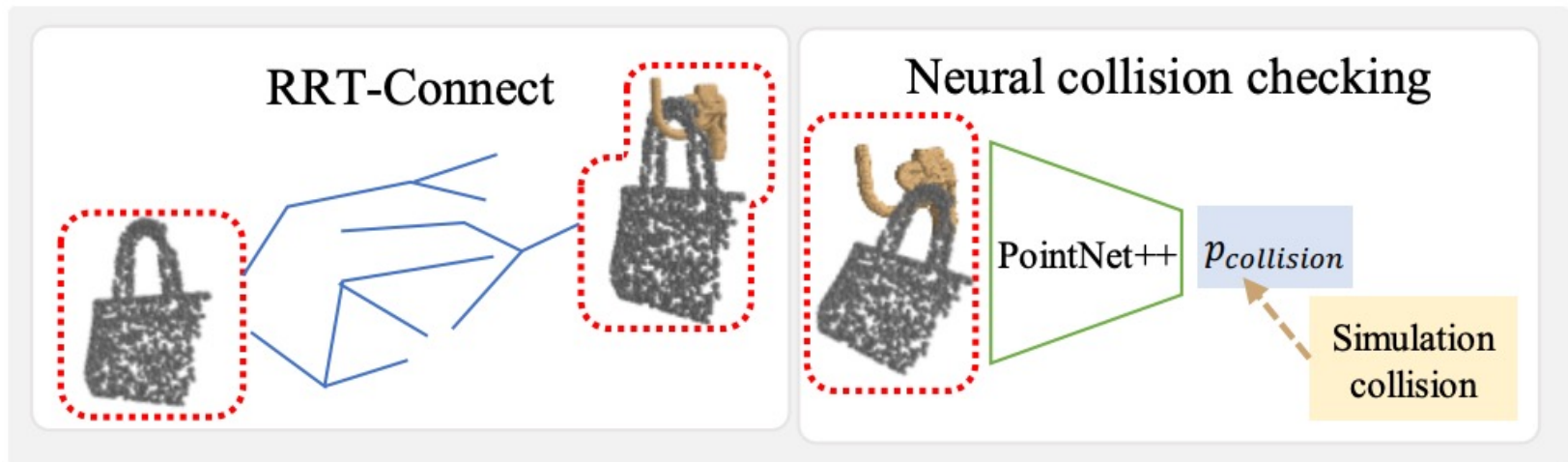
Reward from stability in sim

$$a^* = \arg \max_a \mathcal{V}(\{\mathcal{T}_a \bar{P}_i^O\}^M, \{P_j^S\}^M)$$

Refine hanging pose with RL

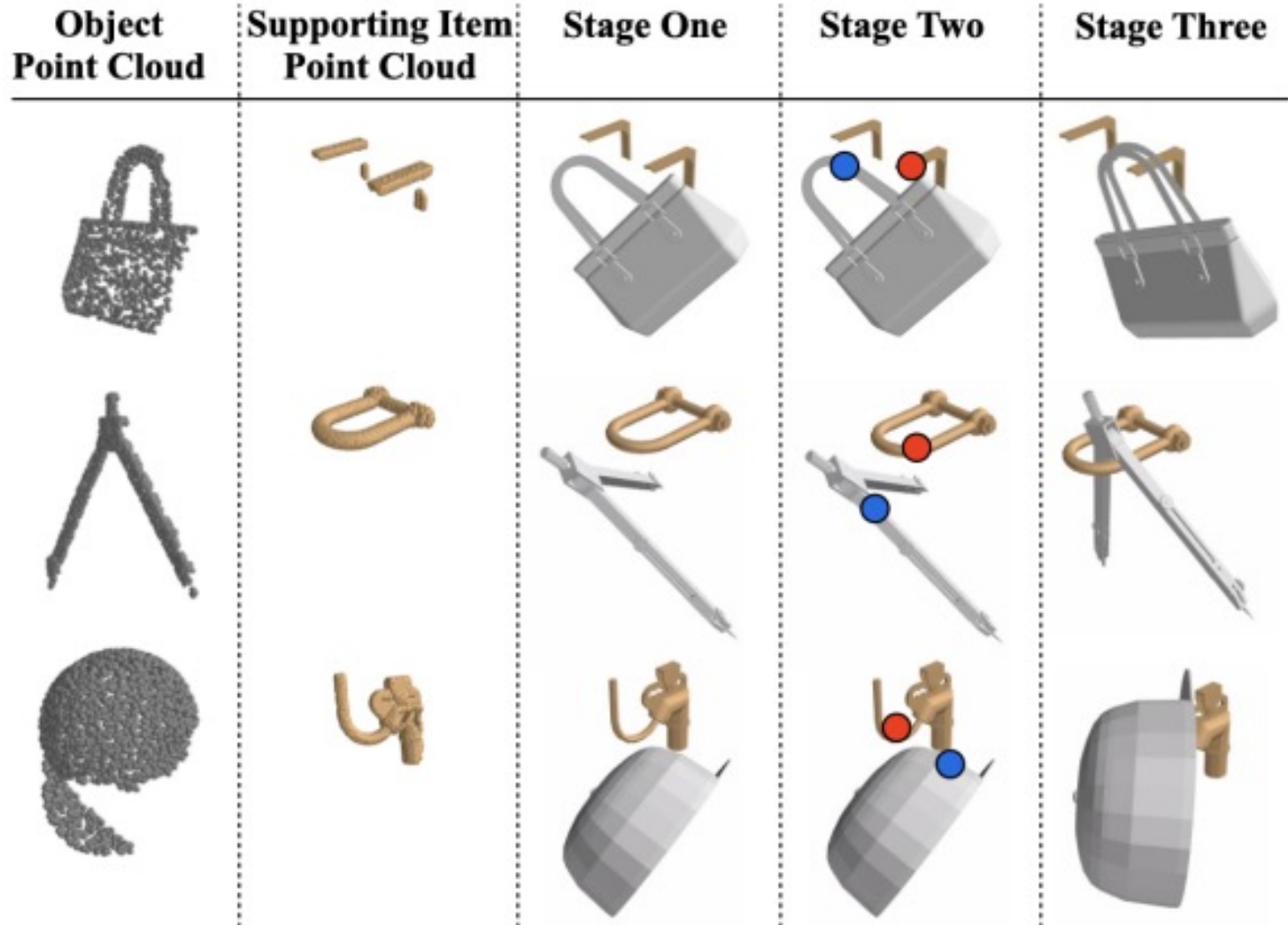
2. How to hang

Neural path planning

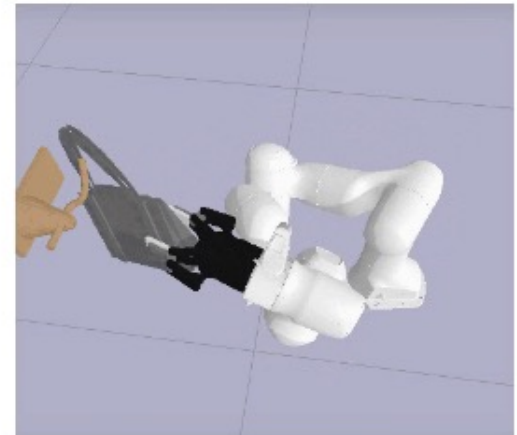
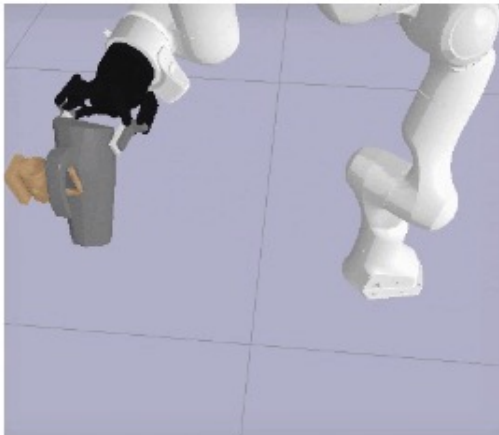
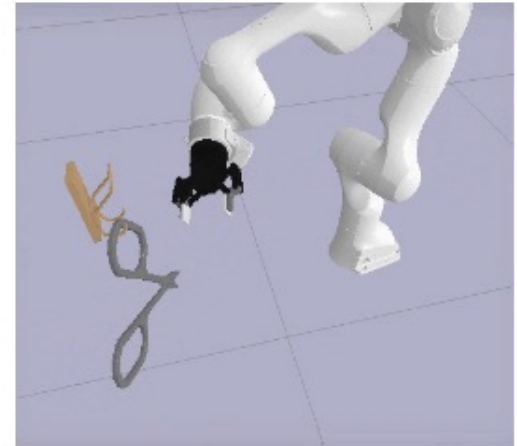
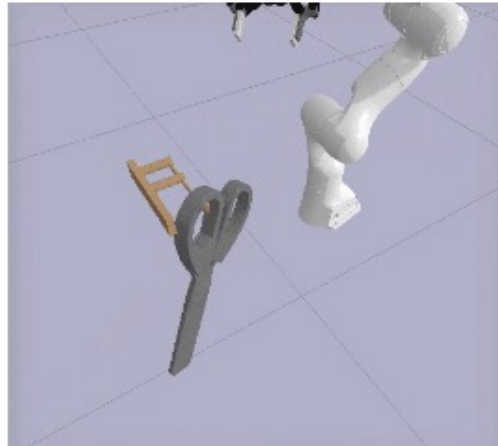
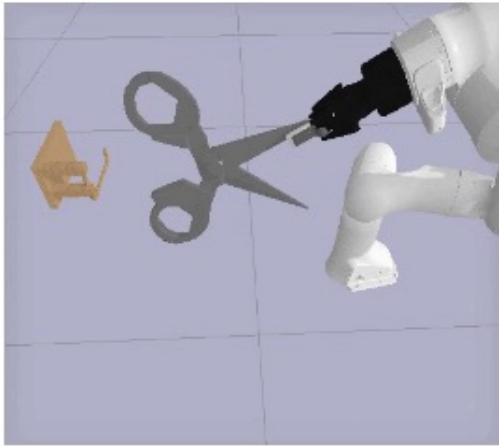


- **Partial observability**
- **Collision free path**

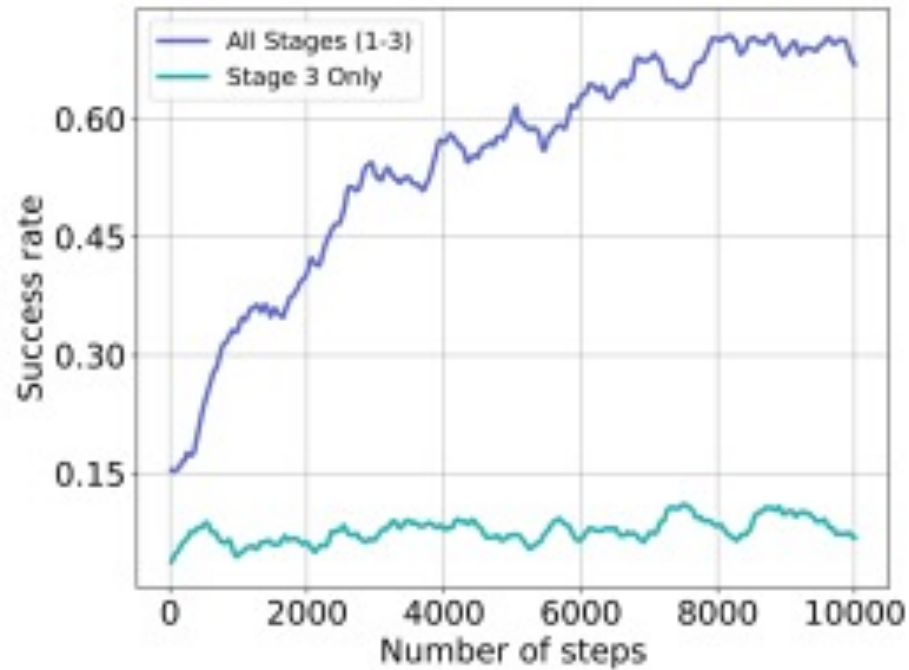
Results



Result



Ablation study



Methods	Mean	Bag	Cap	Hanger	Utensil	Headphone	Knife	Mug	Racquet	Scissors	Wrench	Others
Stage 1 only	36.0	50.0	58.5	44.0	17.7	41.2	26.0	30.3	28.7	22.5	21.5	30.7
Stages 1+2	34.2	47.4	55.7	56.0	20.1	30.2	30.8	20.7	27.6	22.1	27.9	30.0
Stages 1+3	56.2	63.6	60.8	69.1	37.8	60.9	46.2	44.4	44.8	55.4	41.9	58.1
All Stages (1-3)	68.3	78.3	60.2	72.2	45.1	80.5	49.0	61.9	49.4	66.2	55.2	71.5

Whole framework achieved 68.3% success rate

Tackle point



Unstable Goal Pose



Collision

Q&A

- **Any question?**

Quizz

Q1. Which type of data does this method gets?

- a. point cloud**
- b. graph**
- c. RGB image**
- d. configuration**
- e. voxel**

Quizz

Q2. How many stages does Omnihang has for inferring “where to hang” process.