



IFOR: Iterative Flow Minimization for Robotic Object Rearrangement

Rearrangement



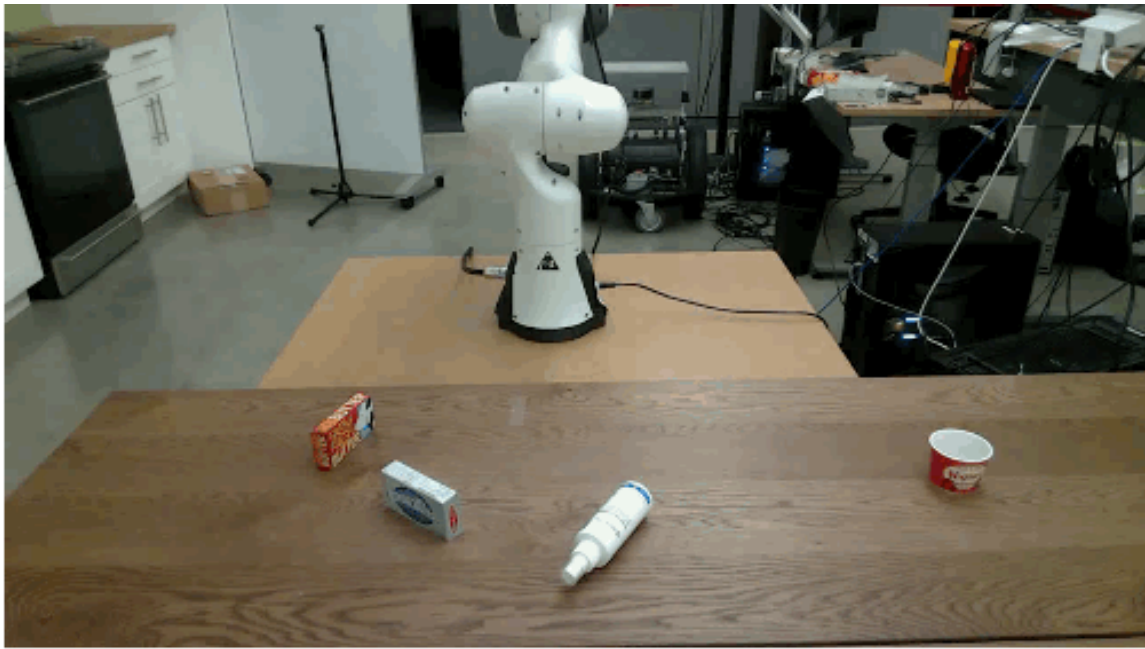
Current Scene



Target Scene

- **Input:** RGBD of the target and current

Rearrangement



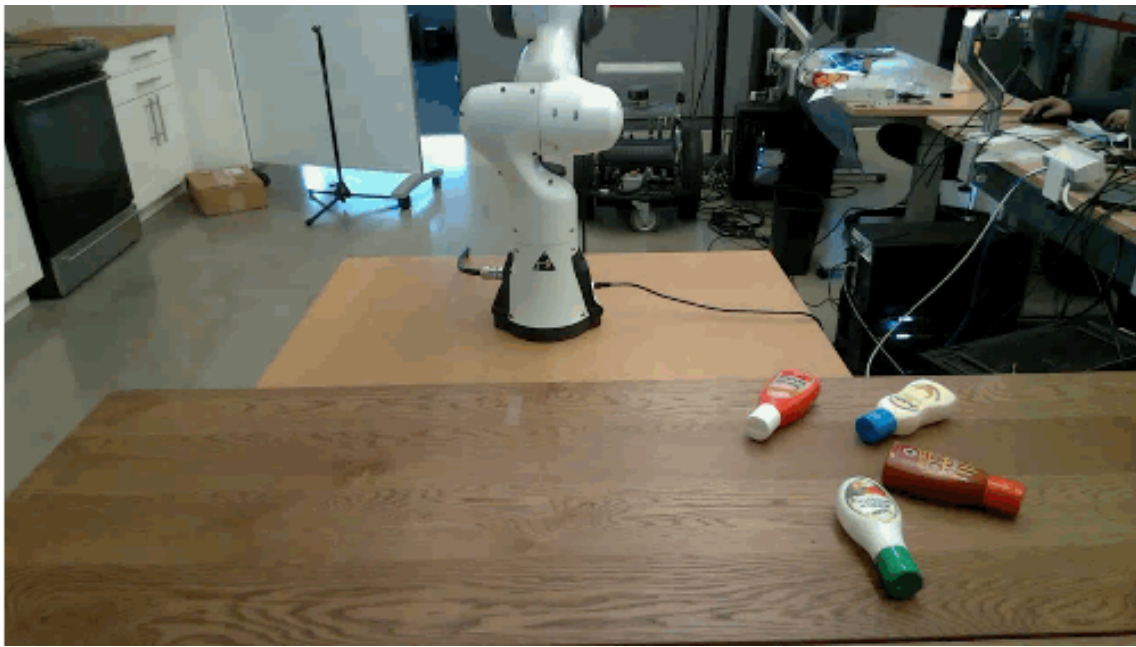
Current Scene



Target Scene

- **Input:** RGBD of the target and current
- **Objective:** Rearrange to the target configuration

Rearrangement



Current Scene



Target Scene

- **Input:** RGBD of the target and current
- **Objective:** Rearrange to the target configuration

Rearrangement



Setting Dinning Table



Cleaning House

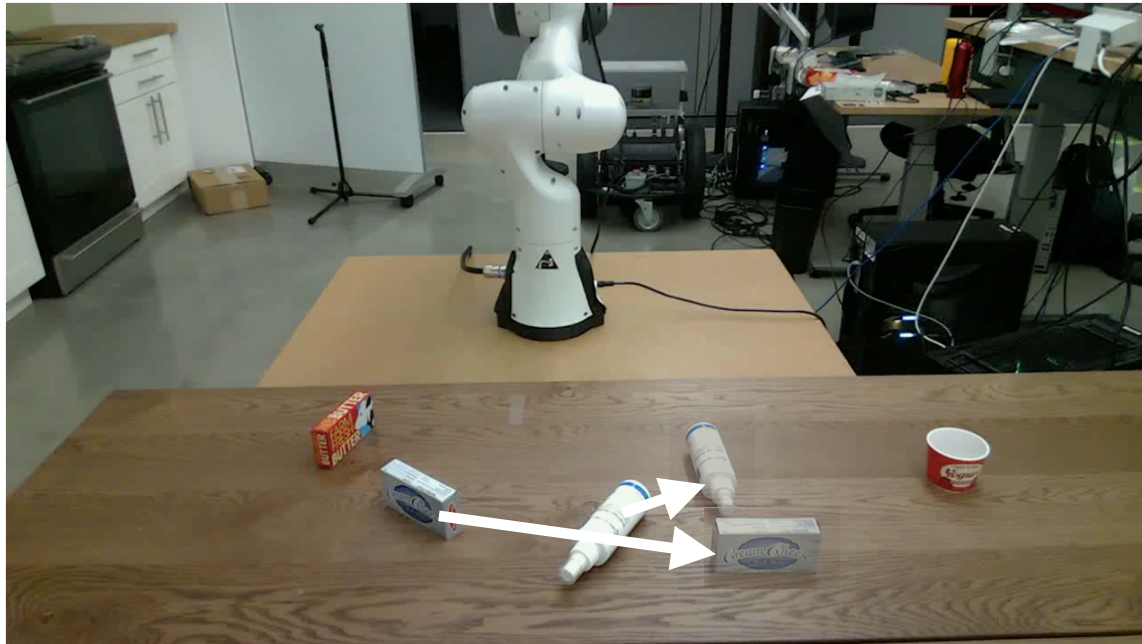


Organising Cabinets

Canonical task for Embodied AI [1]

[1] *Batra, Dhruv et al. "Rearrangement: A Challenge for Embodied AI"*

How to Rearrange?



Current Scene

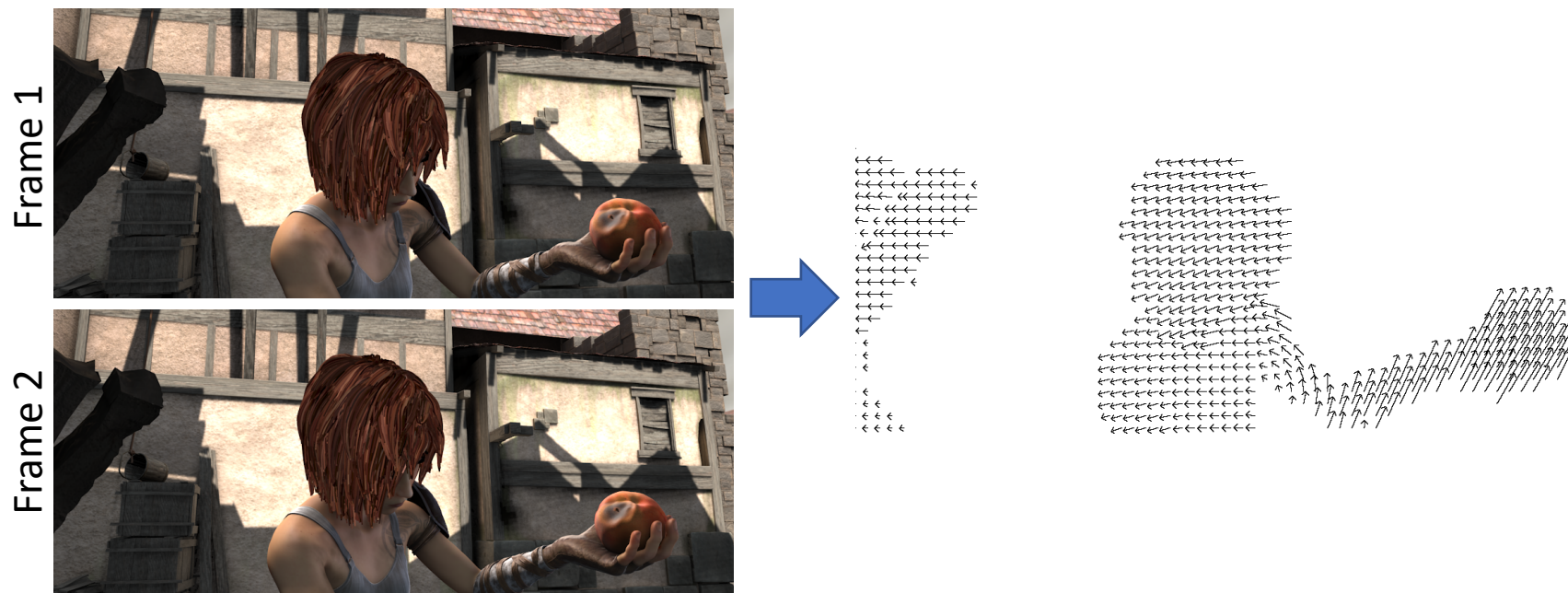


Target Scene

Need to recognize the change in pose of objects.

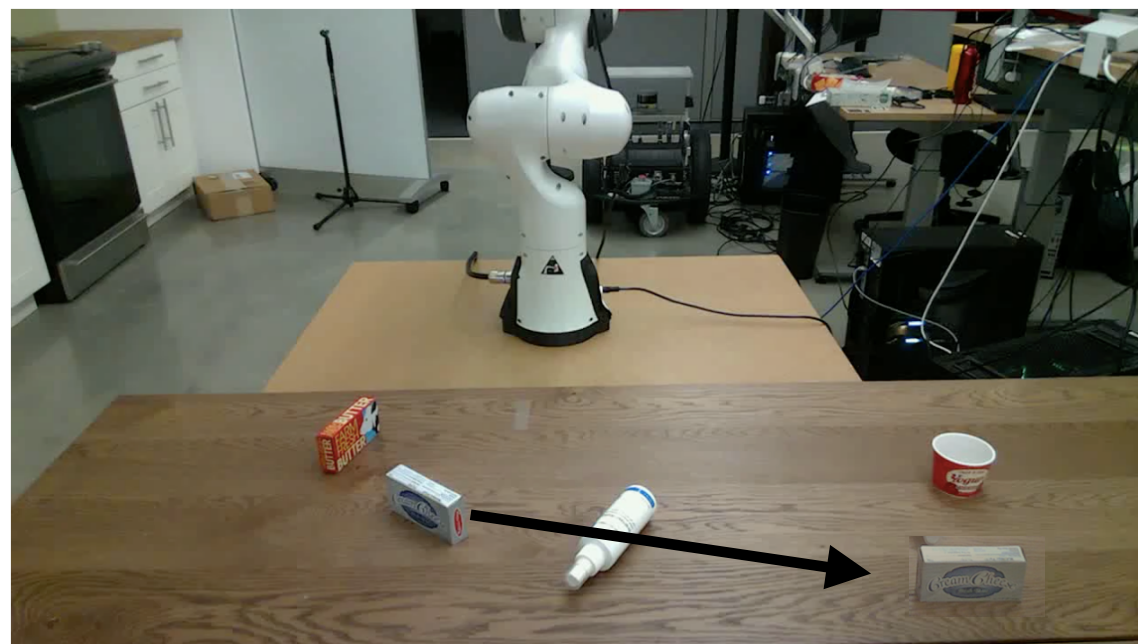
Challenges

- Unseen objects
- Traditional pose estimator won't work 😞
- Object-invariant intermediate representation like flow?
- Solve rigid-body transform from flow (+ segmentation) 😊



Challenges

- Flow values large
- Traditional flow estimators won't work 😞
- A **suitable** neural flow estimator with trained **correct** data?
- Works very well! Transfers from sim-to-real in zero shot 😊



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Current Scene

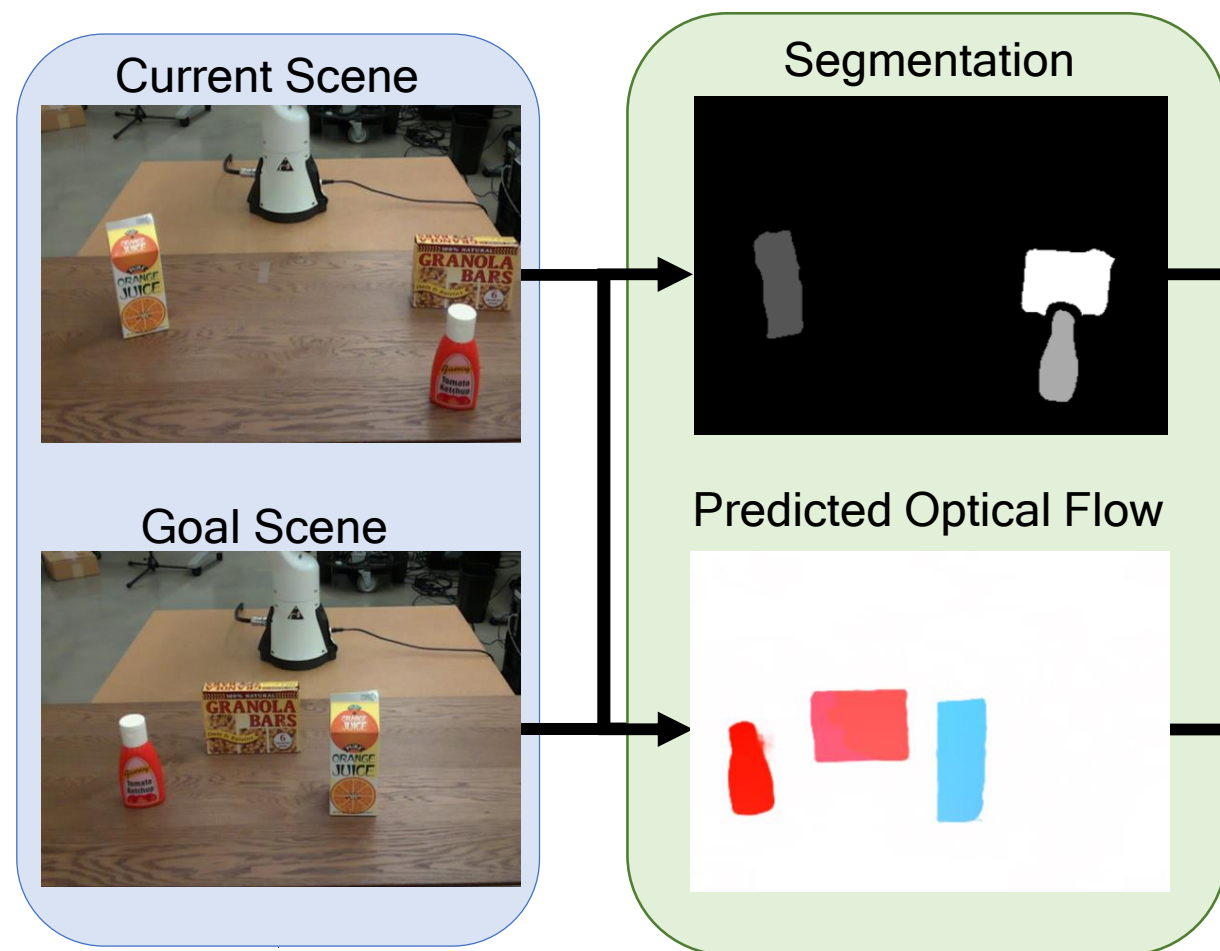


Goal Scene



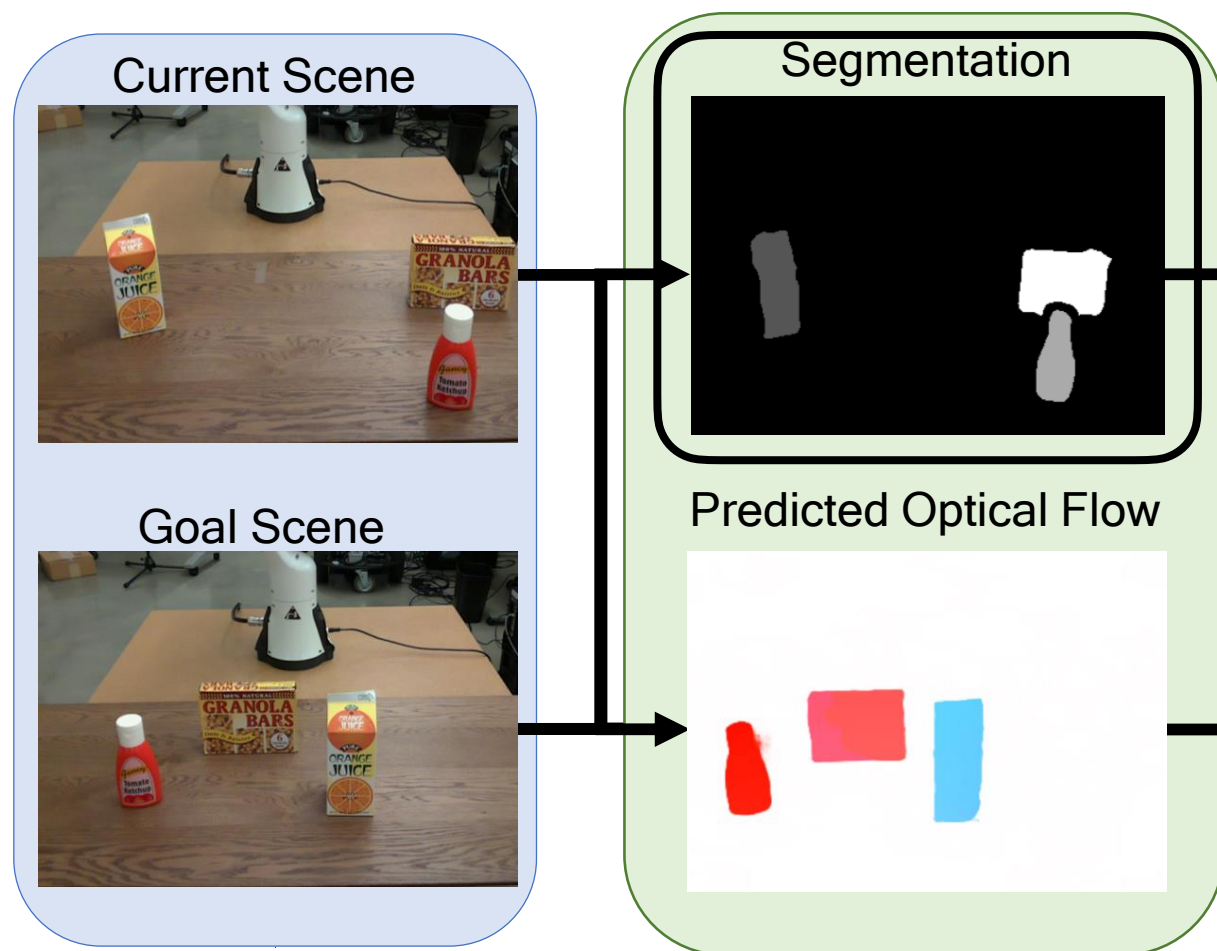
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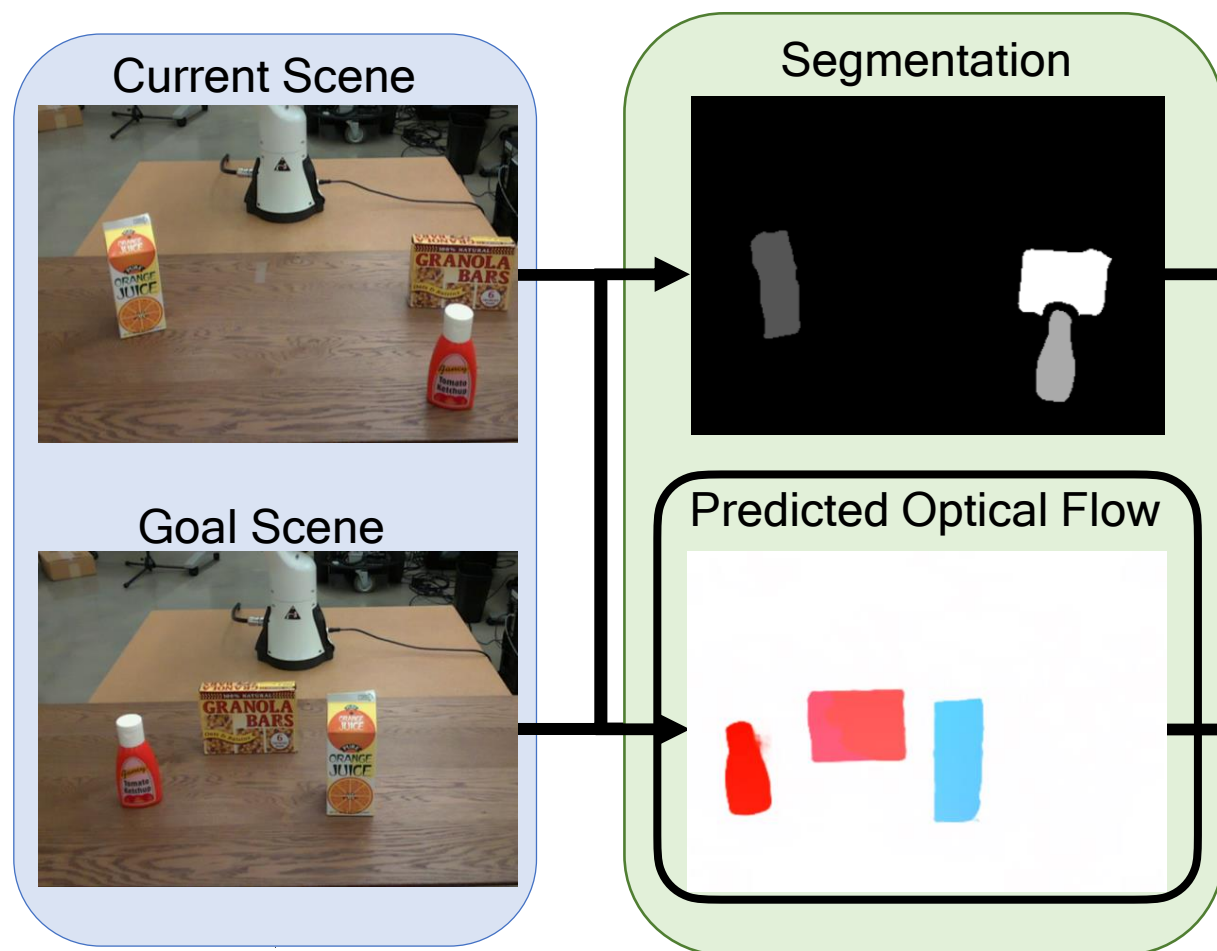


Off-the-shelf Unseen Object Segmentation [1]

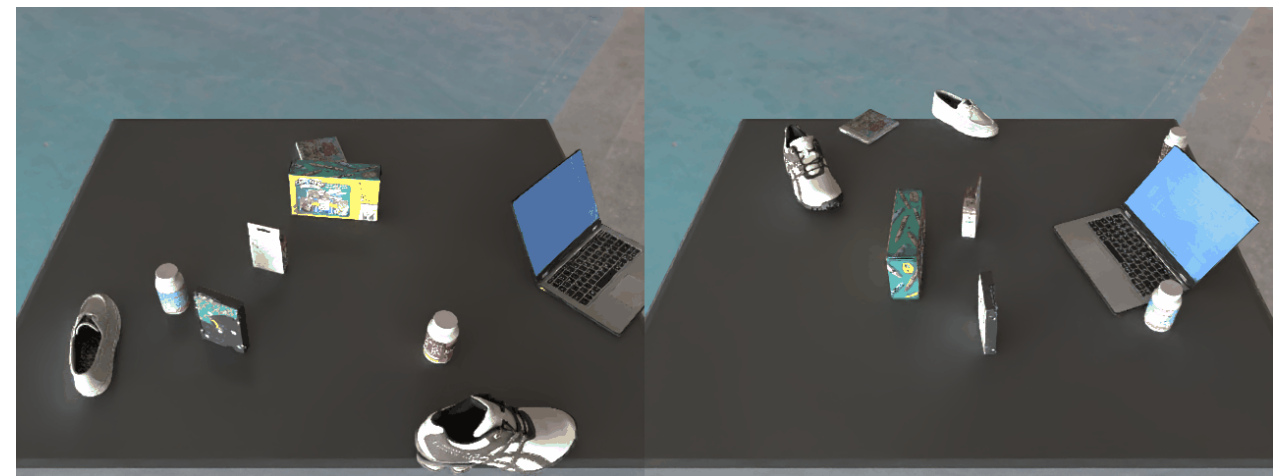
[1] Xiang et al. "Learning RGB-D feature embeddings for unseen object instance segmentation"

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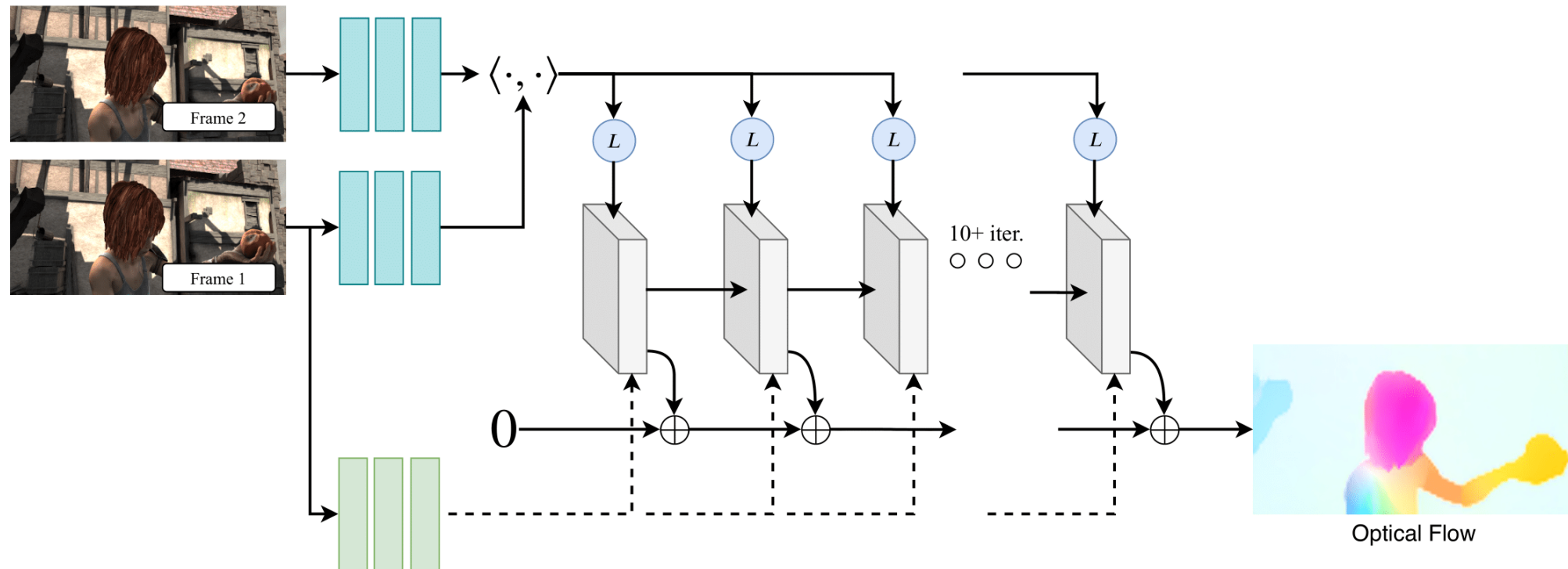
IFOR: Optical Flow



Synthetic Dataset For Rearrangement — NVISII Renderer

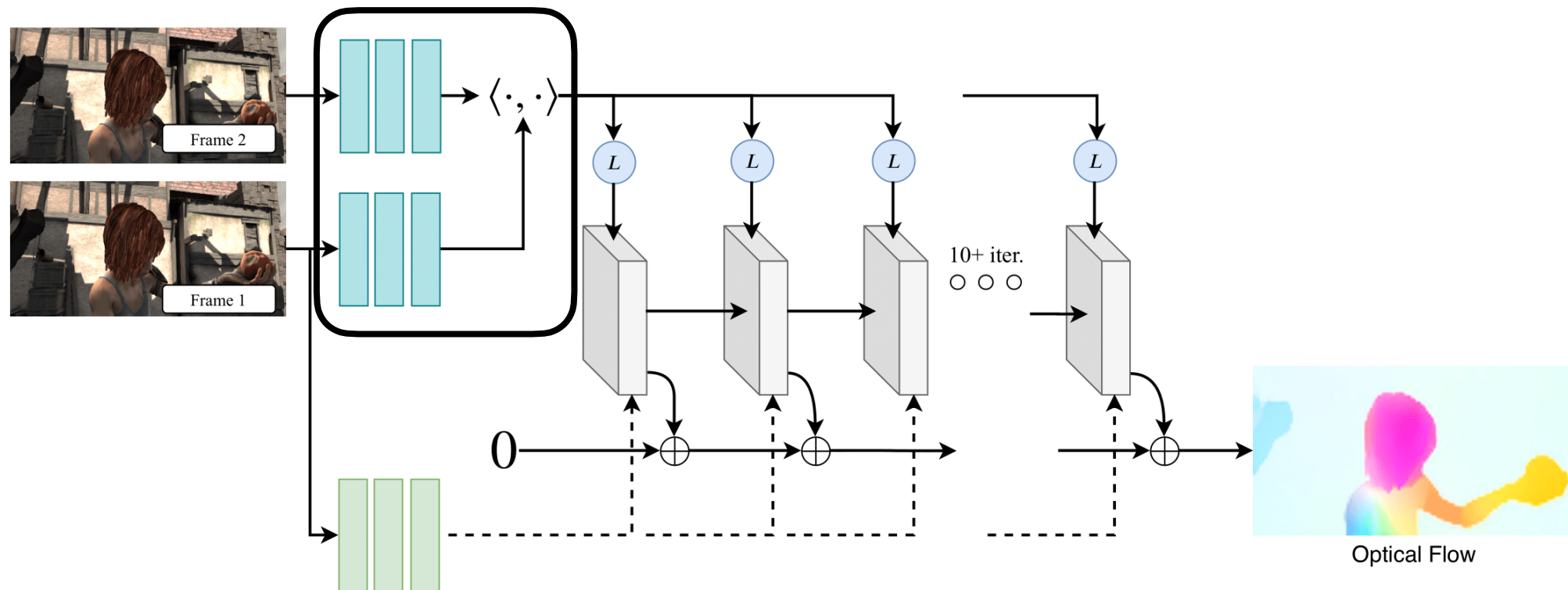
50K Samples for Training

IFOR: Optical Flow



IFOR: Optical Flow

All-Pairs Correlation

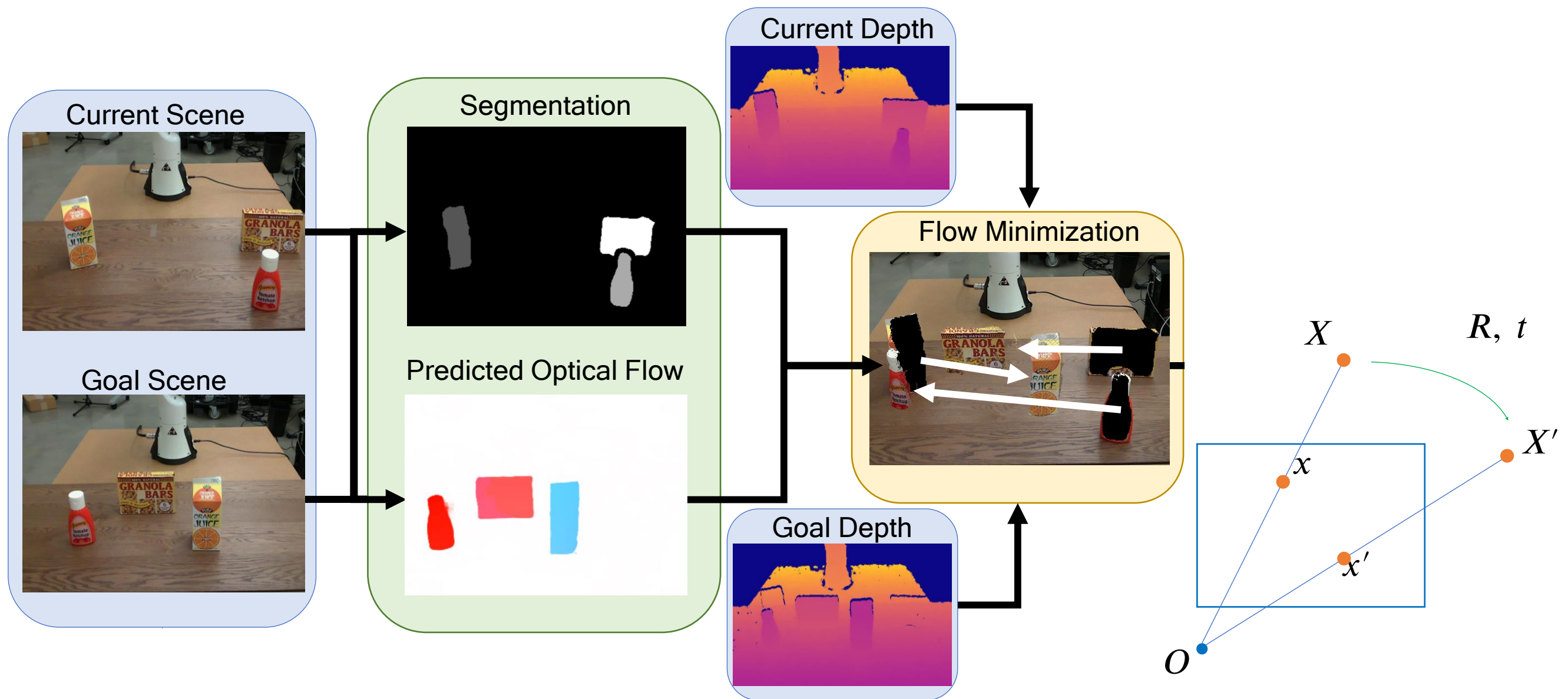


Key Observation:

Compares each pixel to all other pixels => In theory, learn large flows

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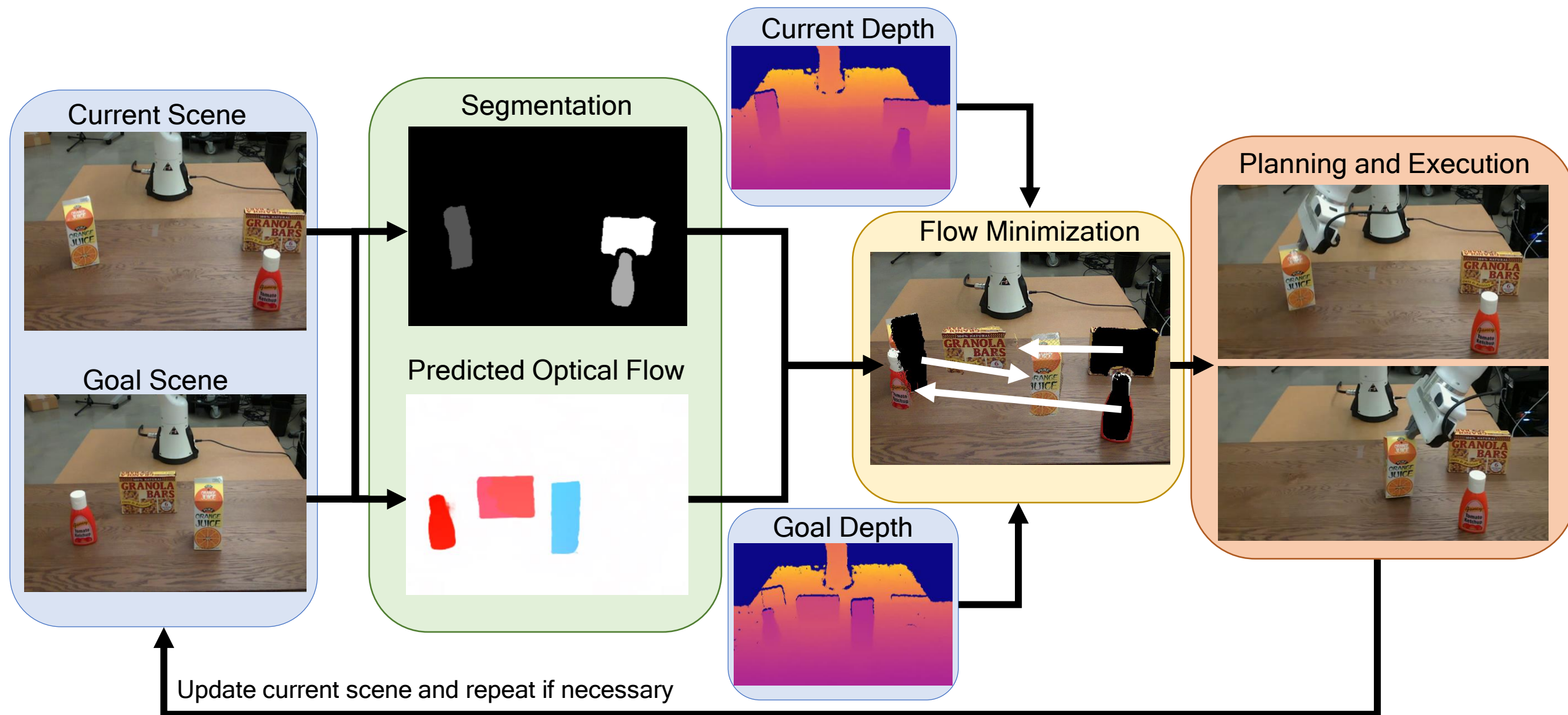
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Solve for rigid-body transformation: **multi-view geometry + RANSAC**

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Example



Target Image



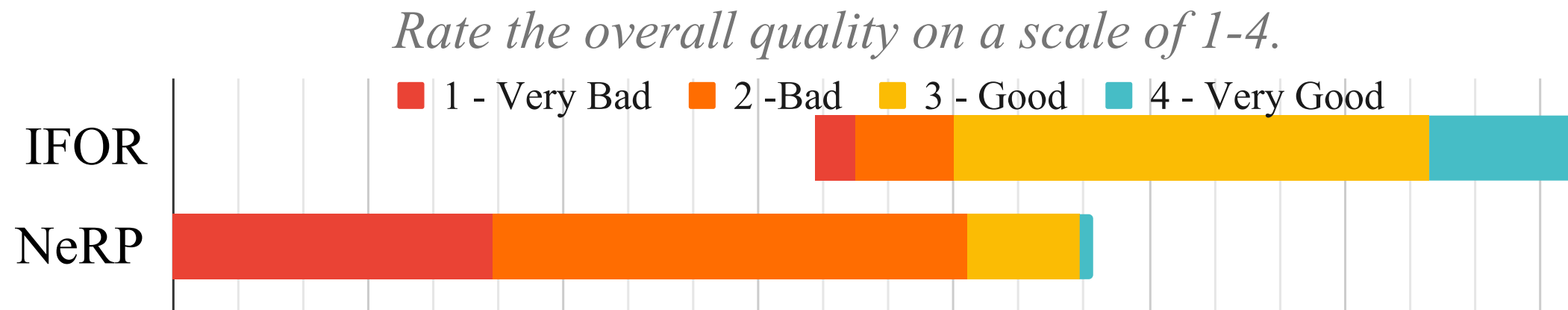
IFOR (ours)

8X

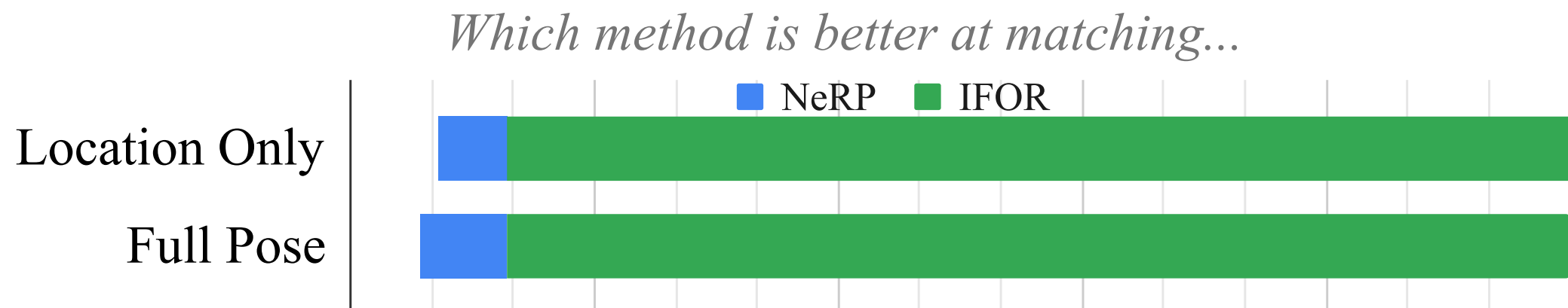


NeRP

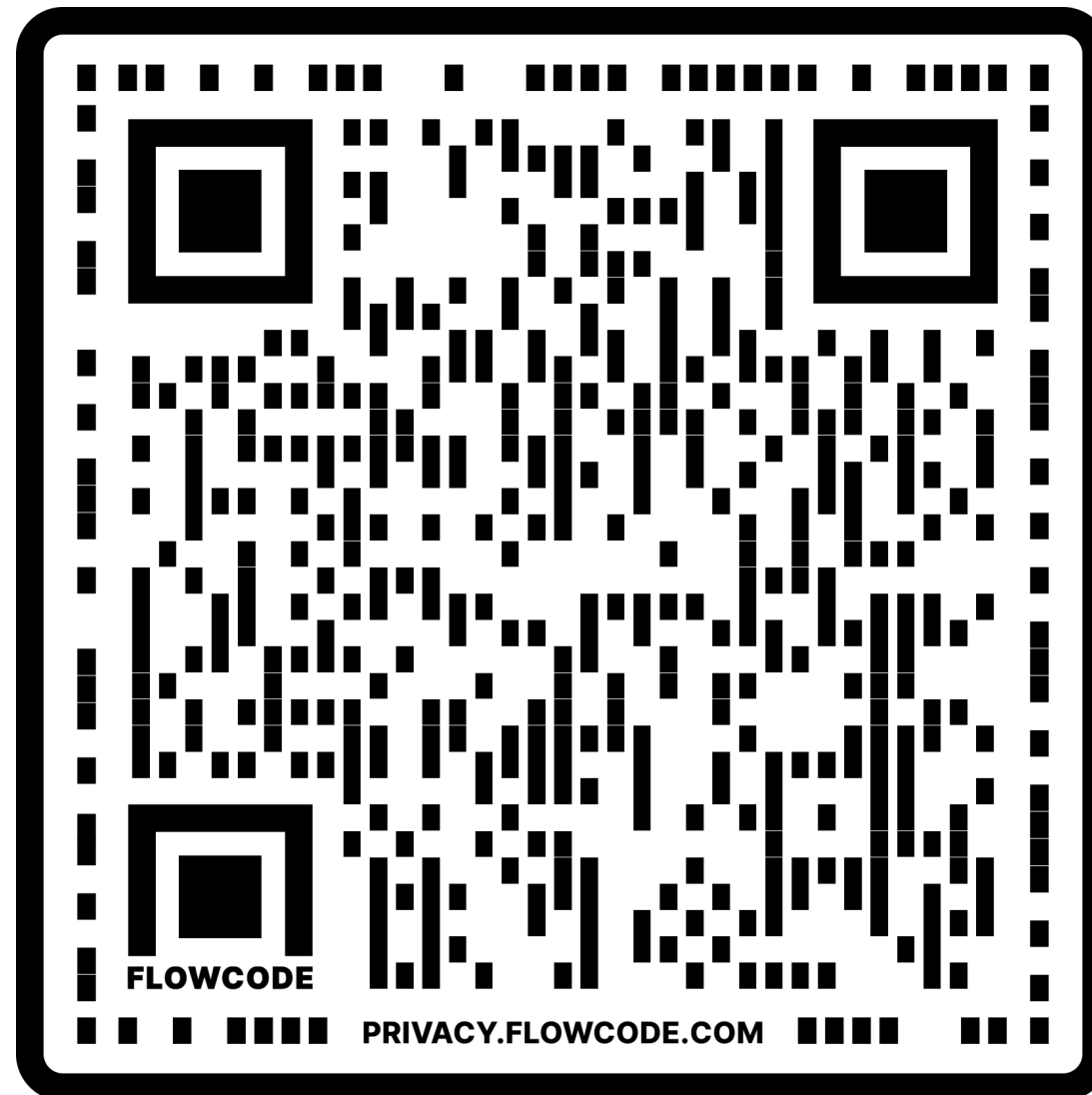
8X



In blind user study, IFOR (ours) was consistently rated to perform good!



>92% of time users preferred IFOR (ours) over prior-art



Project Page: <https://imankgoyal.github.io/for.html>

Poster: 23 June 2022, 2:30 - 5:30 PM, 144B