IFOR: Iterative Flow Minimization for Robotic Object Rearrangement

Rearrangement

Current Scene

Target Scene

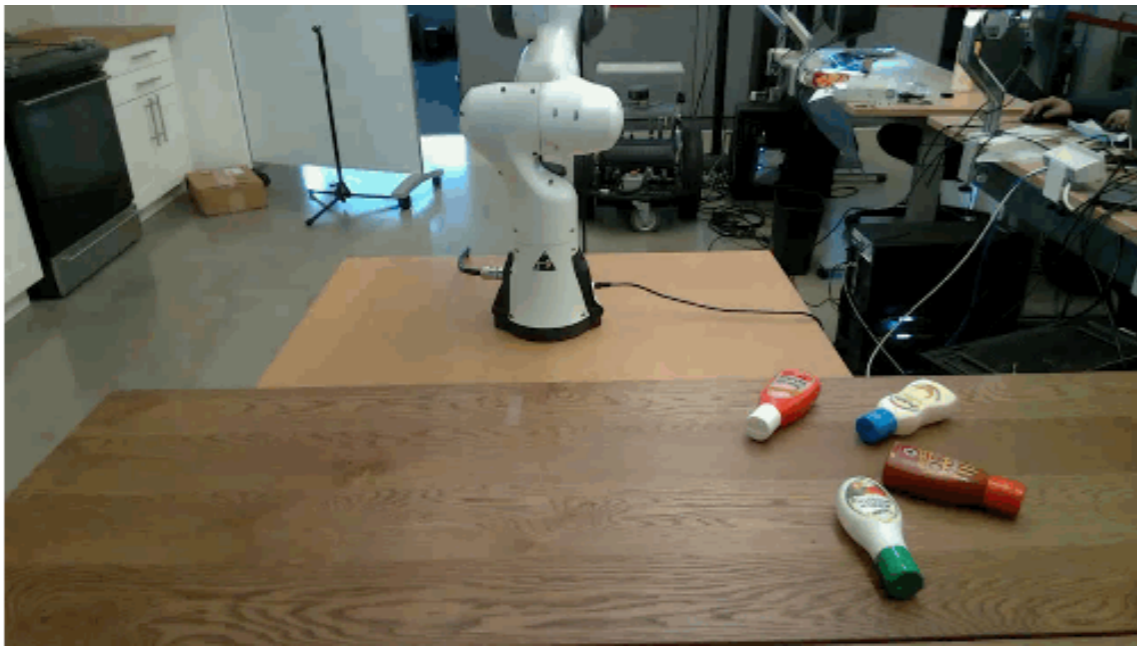- **Input:** RGBD of the target and current

Rearrangement

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

- **Objective:** Rearrange to the target configuration

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Rearrangement

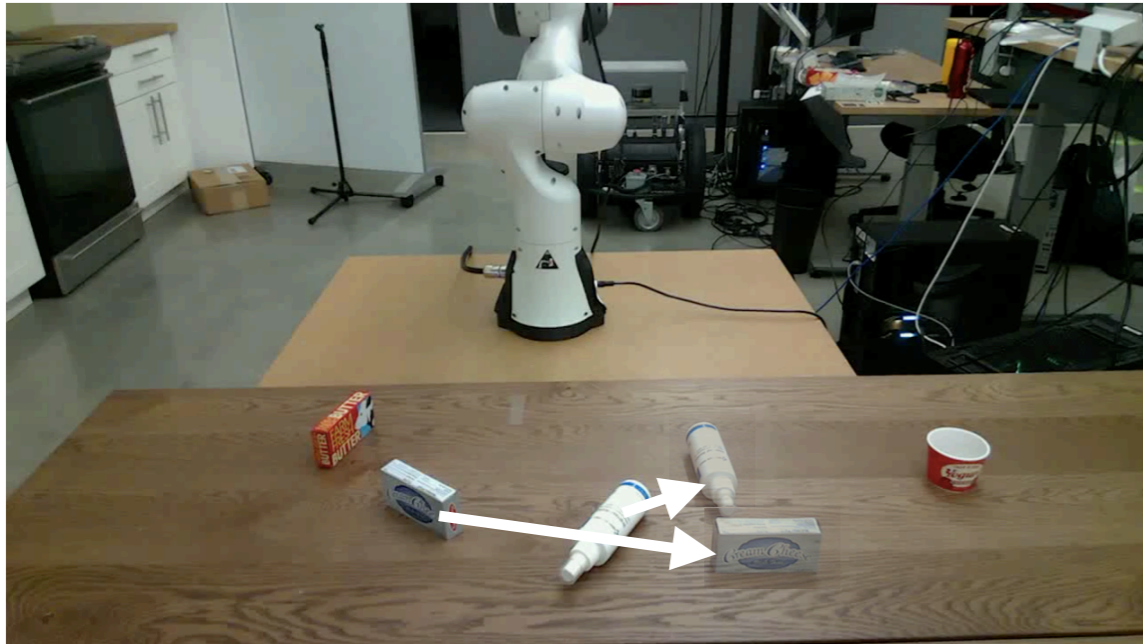**Setting Dinning Table**

Cleaning House

Organising Cabinets

Canonical task for Embodied AI [1]

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

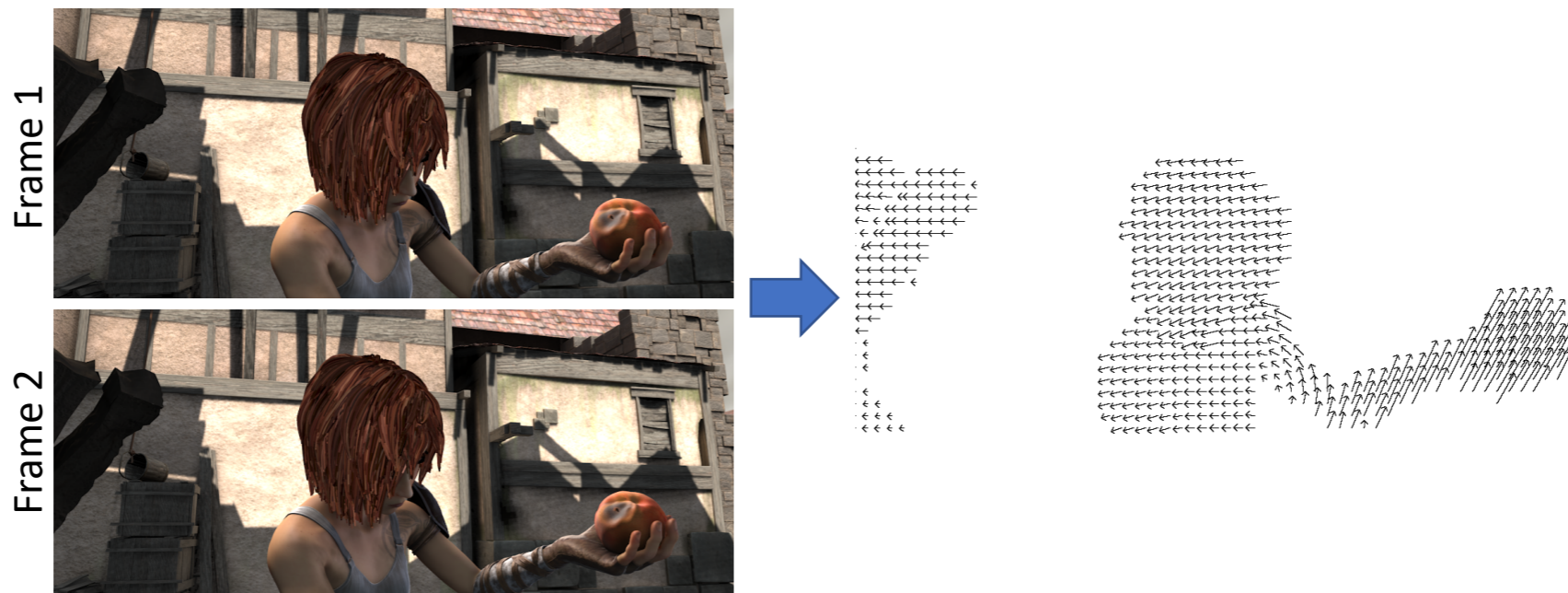# How to Rearrange?

Current Scene

Target Scene

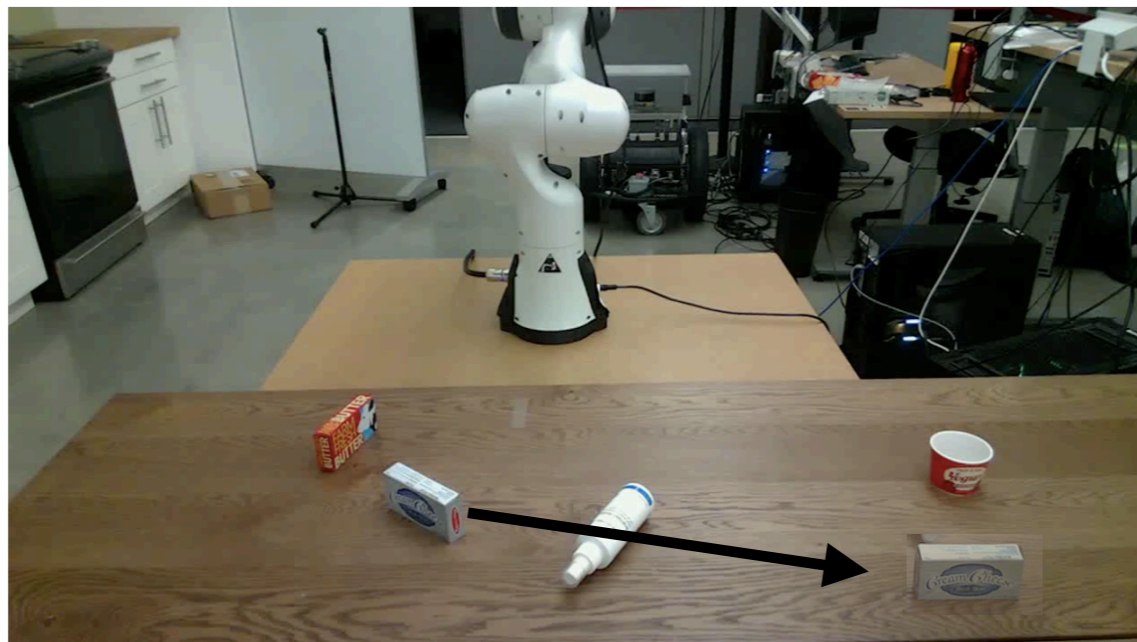*Need to recognize the change in pose of objects.*

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 🙂

IFOR

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IFOR
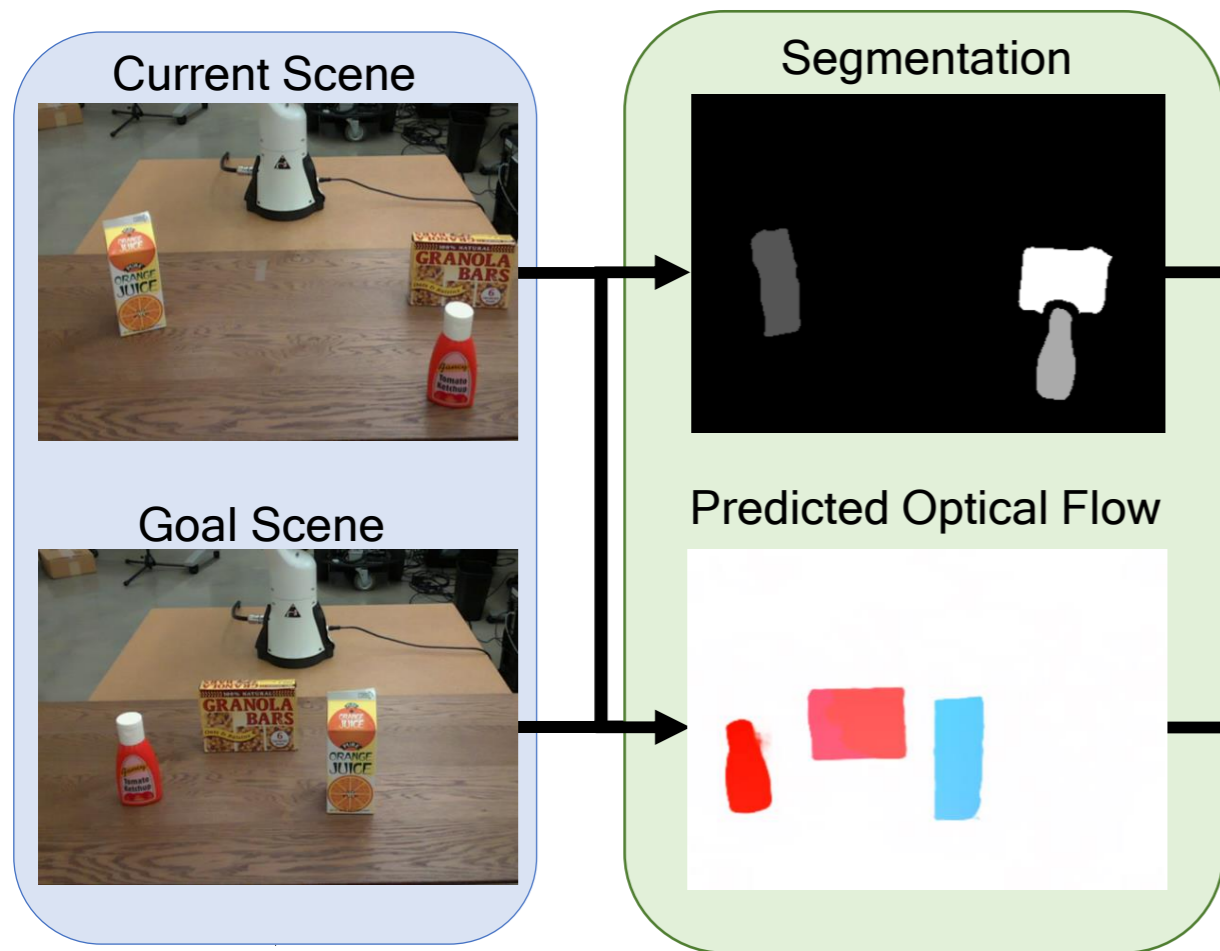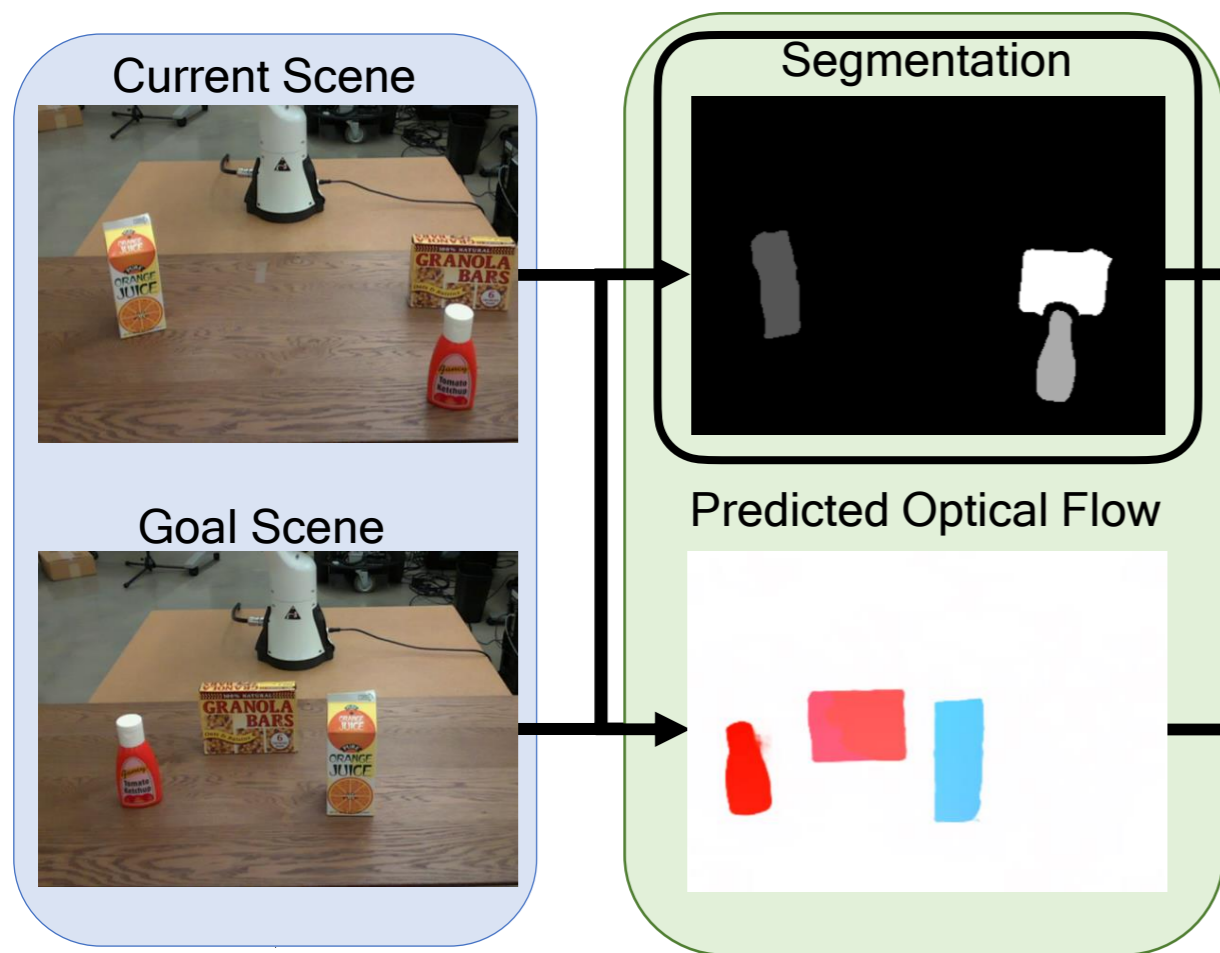
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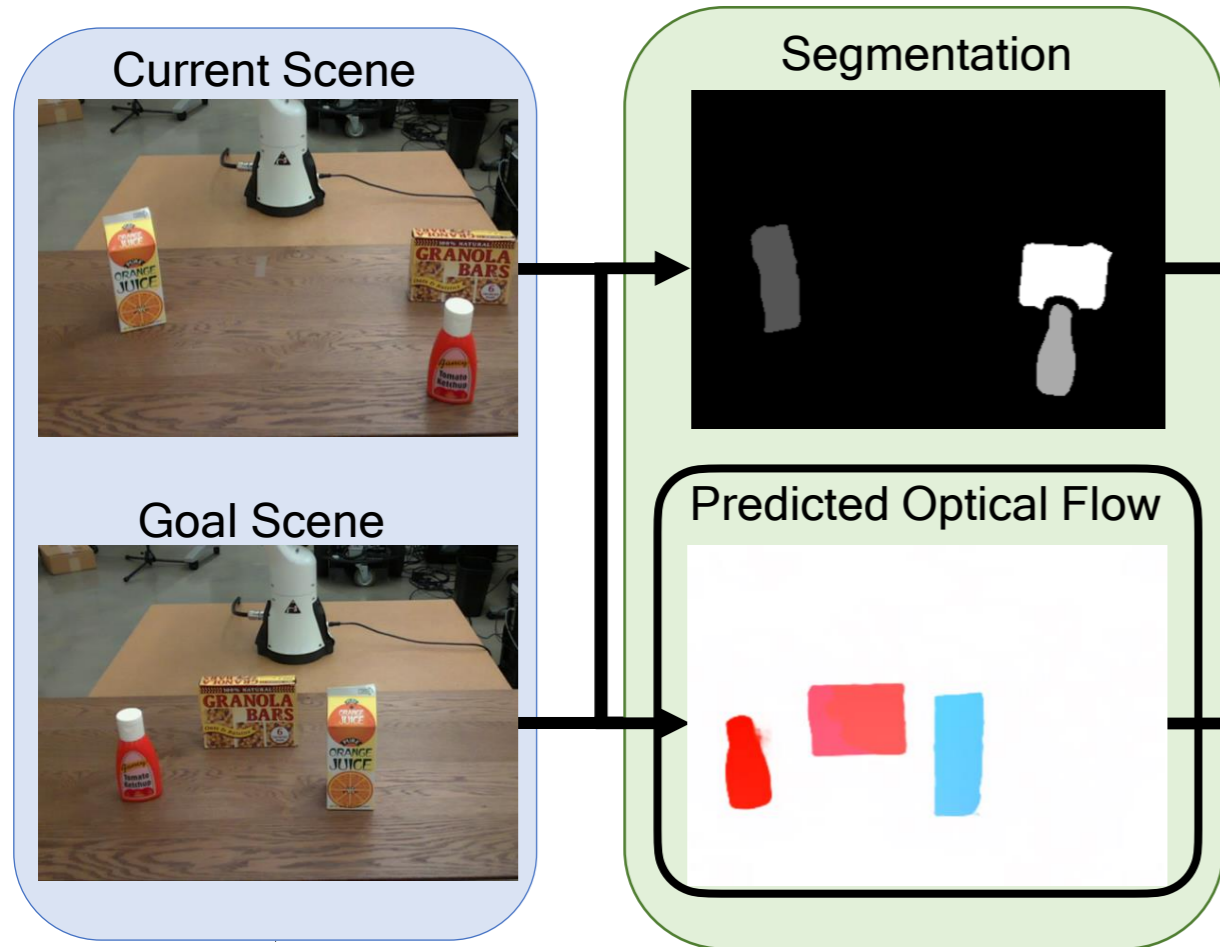Iterative **F**low Minimization for Robotic **O**bject **R**earrangement

Off-the-shelf Unseen Object Segmentation [1]

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

IFOR

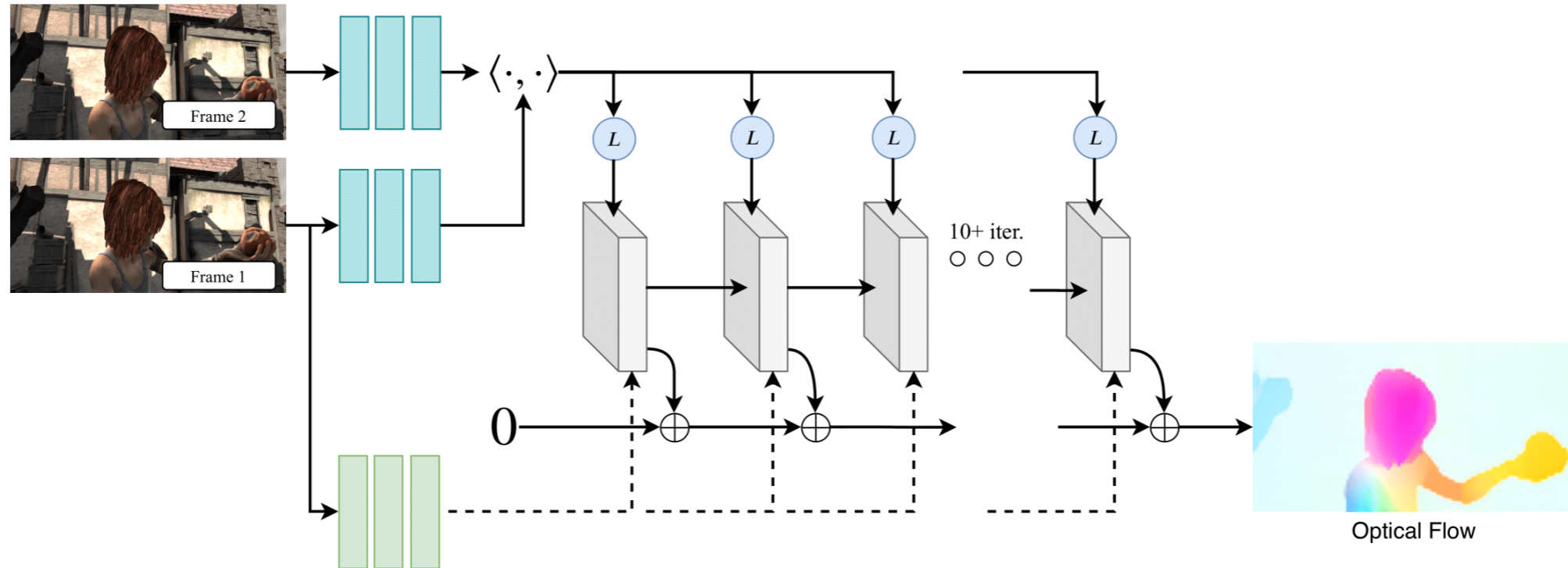Iterative Flow Minimization for Robotic Object Rearrangement

IFOR: Optical Flow
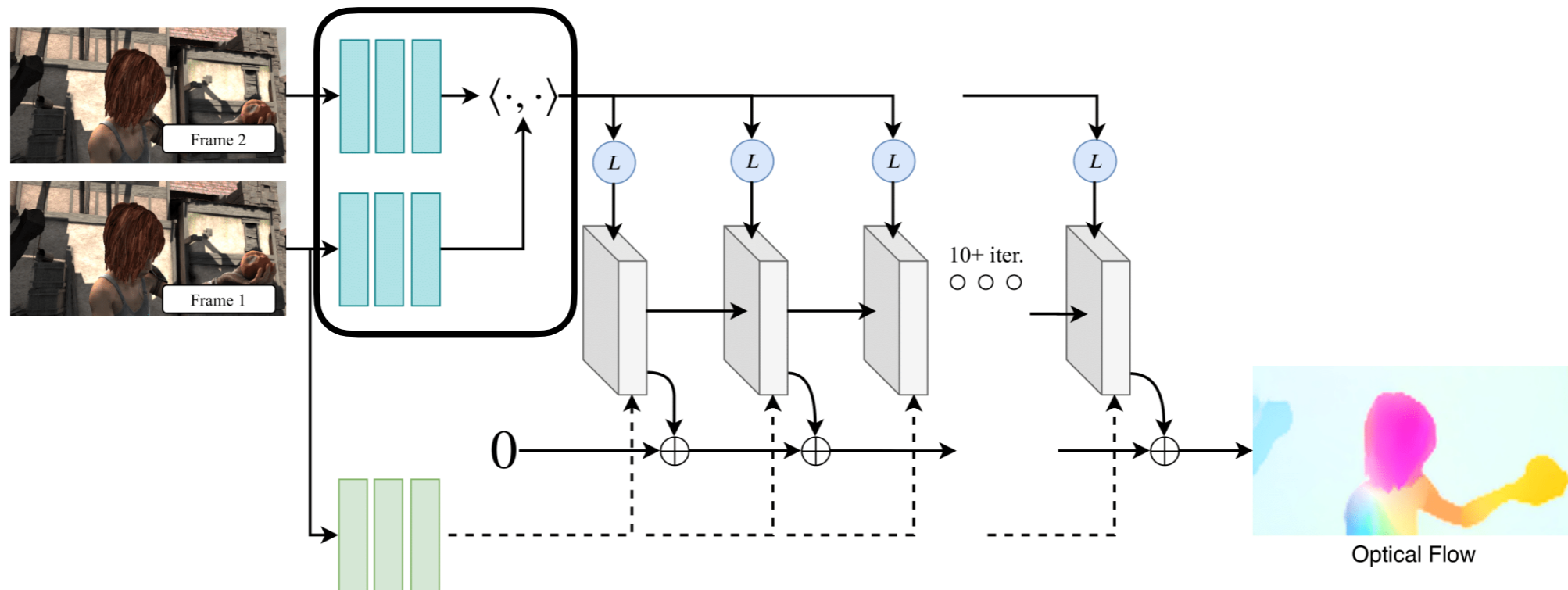

Synthetic Dataset For Rearrangement — NVISII Renderer

50K Samples for Training

IFOR: Optical Flow

Optical Flow

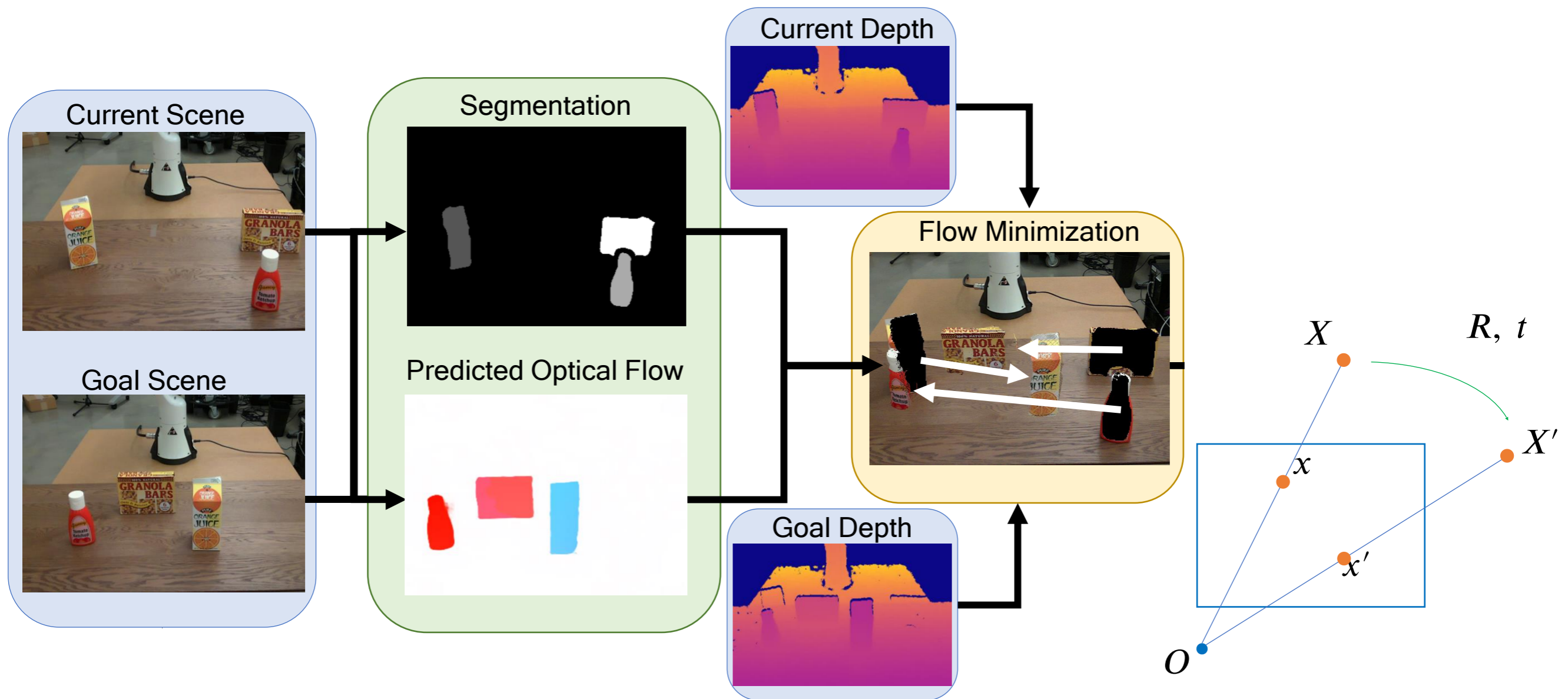[1] Teed, Zach and Deng, Jia "RAFT: Recurrent All-Pairs Field Transforms for Optical Flow"

IFOR: Optical Flow

Key Observation:

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

[1] Teed, Zach and Deng, Jia "RAFT: Recurrent All-Pairs Field Transforms for Optical Flow"
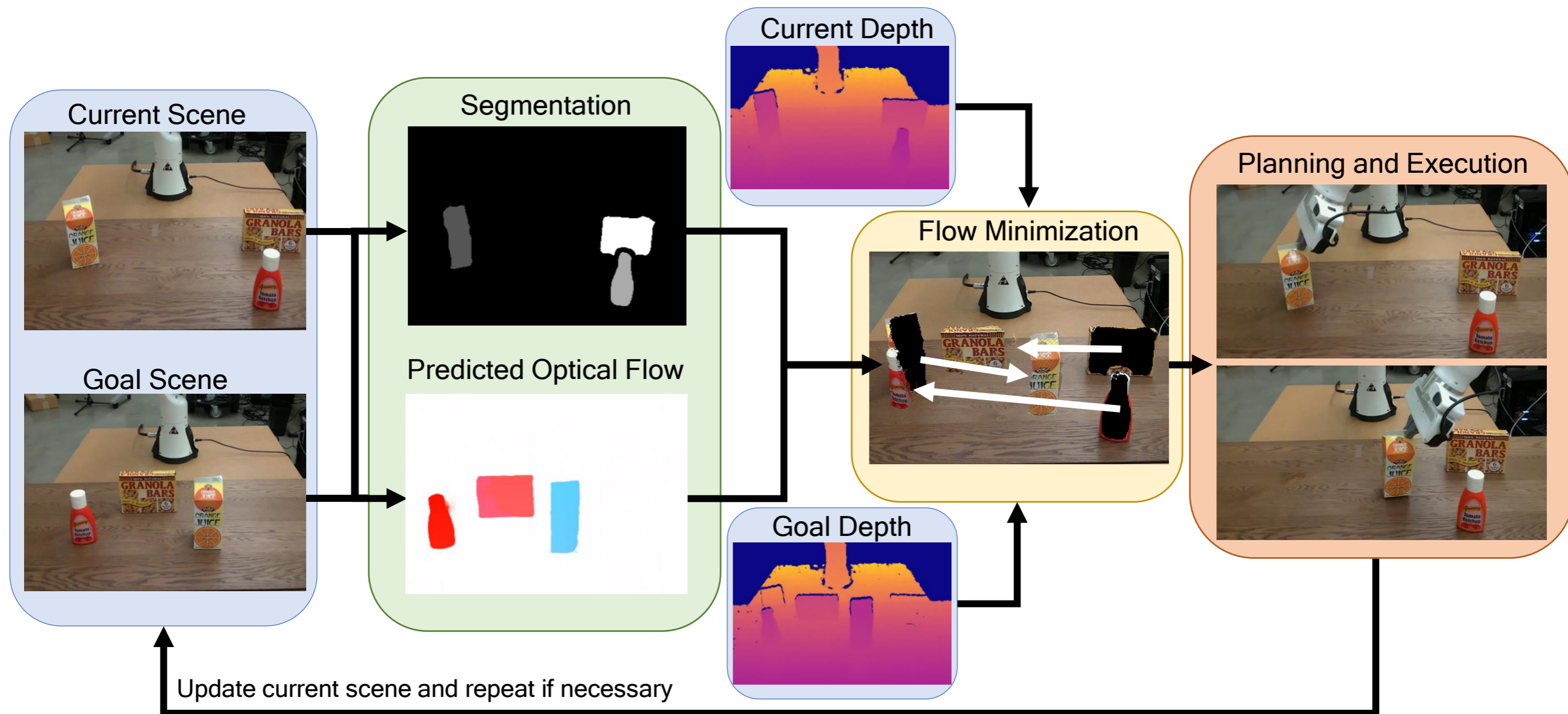
IFOR

Iterative Flow Minimization for Robotic Object Rearrangement

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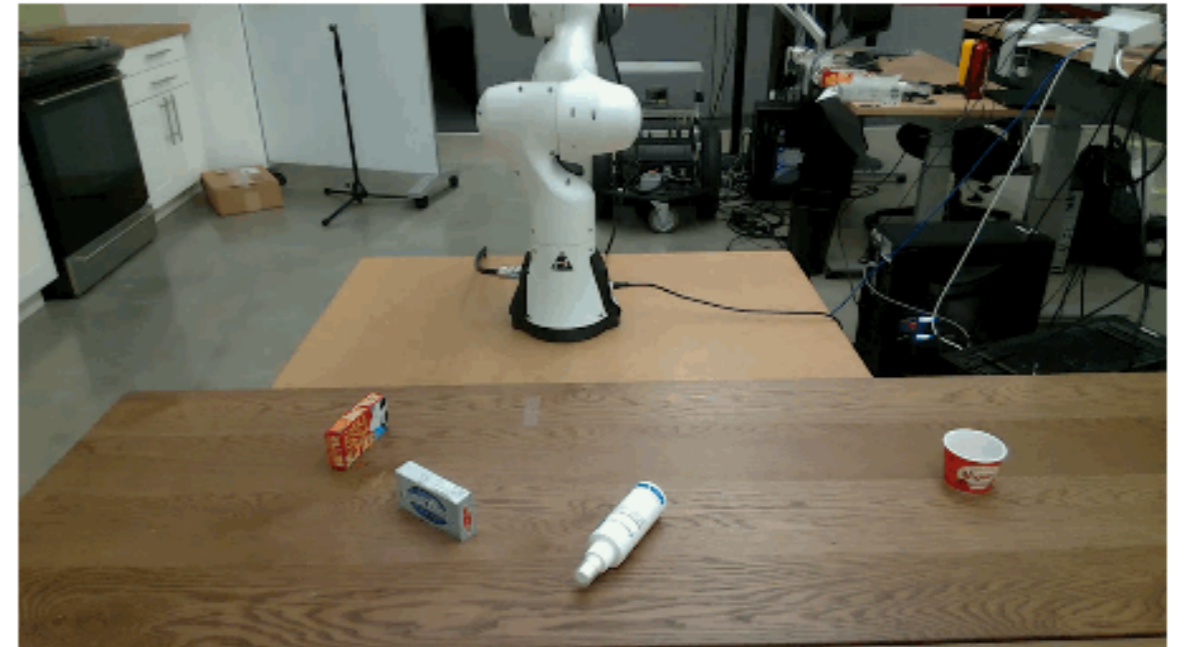
IFOR

Iterative Flow Minimization for Robotic Object Rearrangement
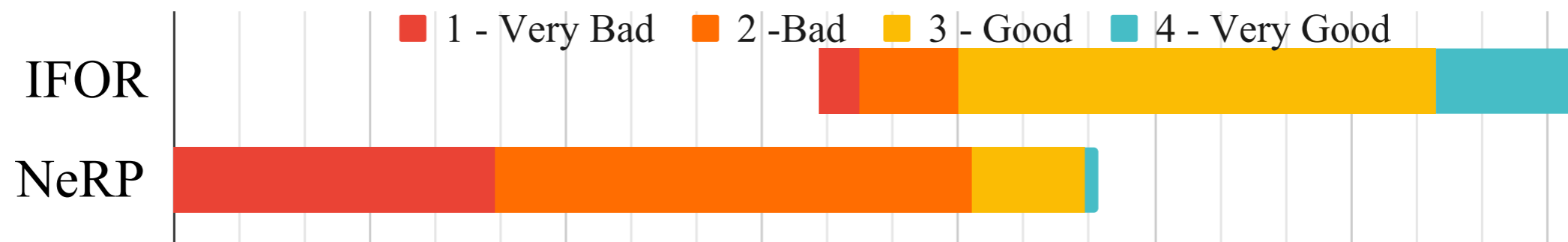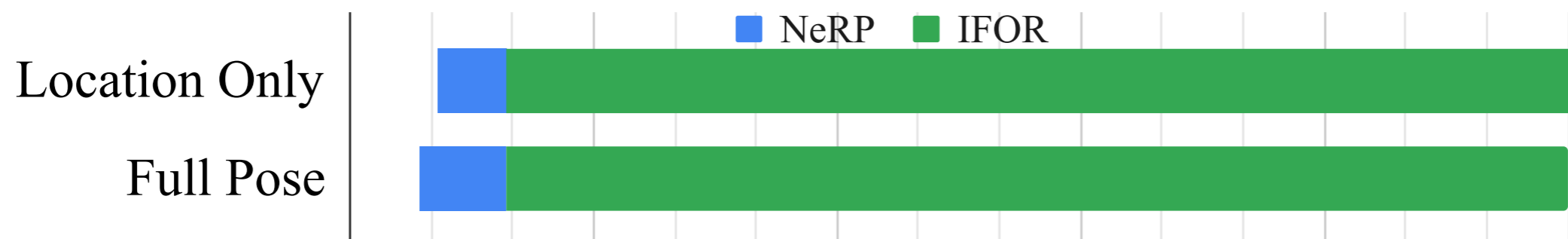
Example

Target Image

IFOR (ours)   8X

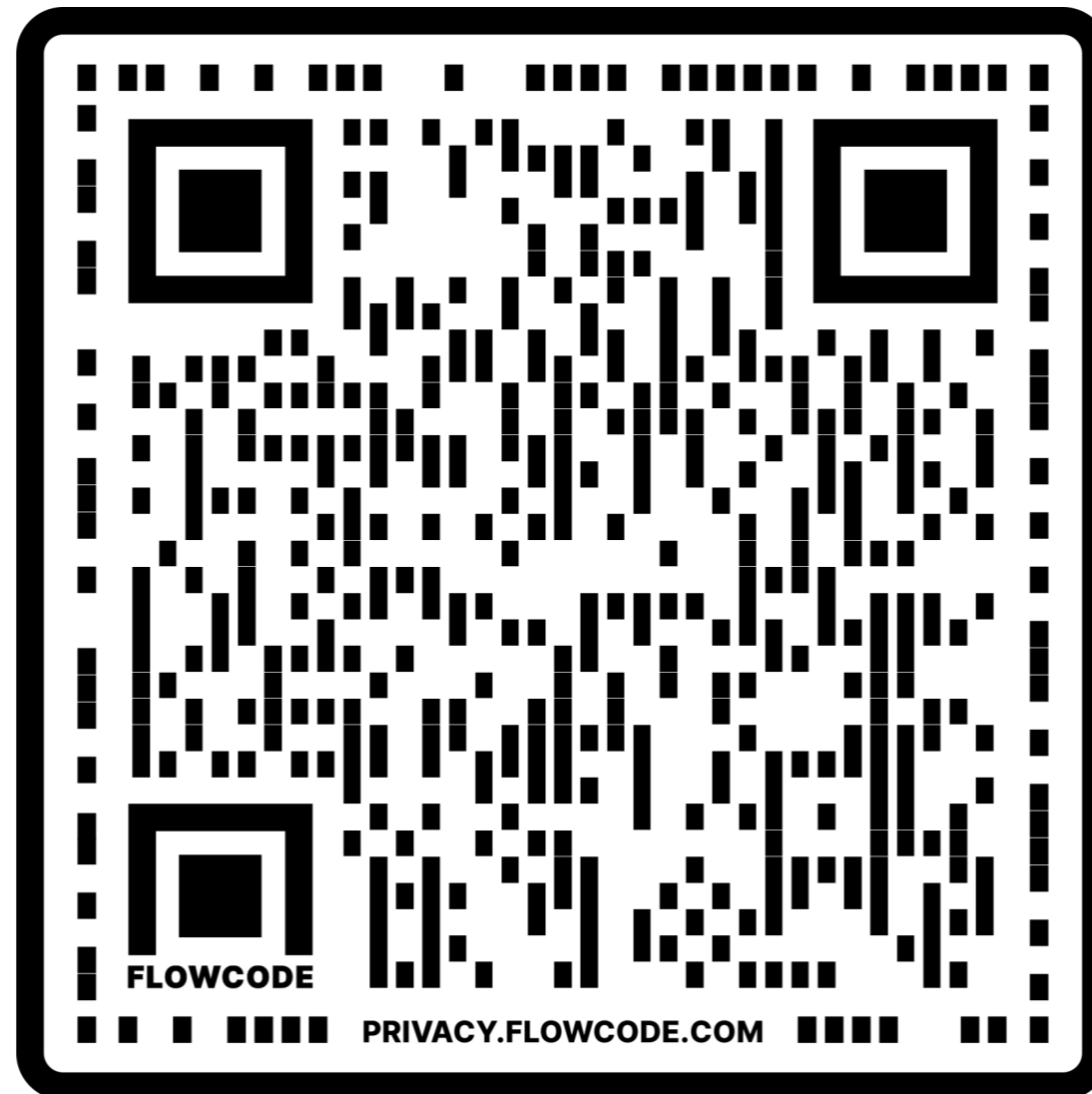NeRP   8X

Rate the overall quality on a scale of 1-4.

1 - Very Bad   2 -Bad   3 - Good   4 - Very Good

IFOR

NeRP

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

Which method is better at matching...

NeRP   IFOR

Location Only

Full Pose

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

Project Page: https://imankgoyal.github.io/ifor.html

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