Object Grasping By Learning Hand-Object Interaction from Human Behaviors

○Masaki Yano, Hiroya Fukuhara, Tadashi Matsuo, Nobutaka Shimada (Ritsumeikan Univ.)

1. Motivation

- There are many kinds of objects which we usually use.
- It is very hard to develop grasping movements about all objects.

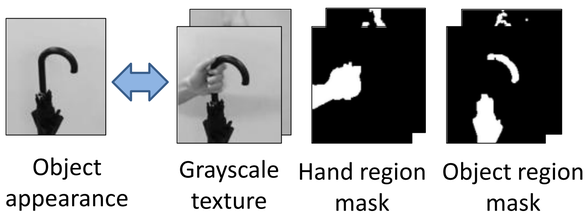
We propose a method that enables a robot to grasp an object based on how a human grasps it.

2. Grasping Pattern Inference

We train a grasping pattern inference model by using “interaction descriptor space[1]”.

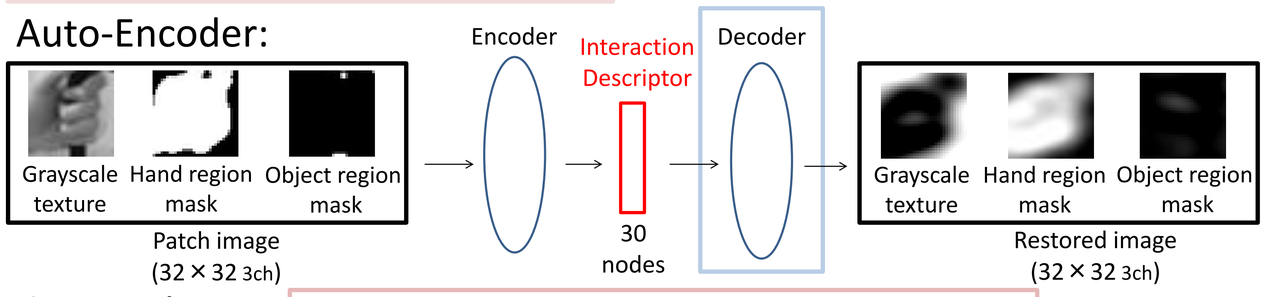
[1]Tadashi Matsuo, Nobutaka Shimada: "Construction of Latent Descriptor Space of Hand-Object Interaction ", The 22nd Joint Workshop on Frontiers of Computer Vision (FCV2016), pp. 117-122, 2016.

Sets of training images

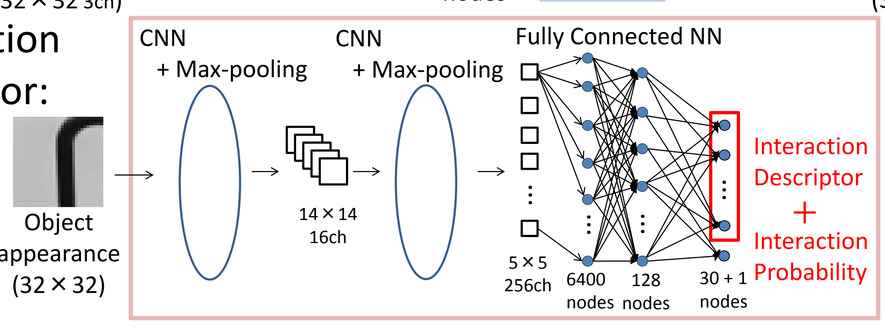


- Training an Auto-Encoder and an Estimator with sets of training images.
- The model can correspond to an unknown object which has similar partial shape to known object.

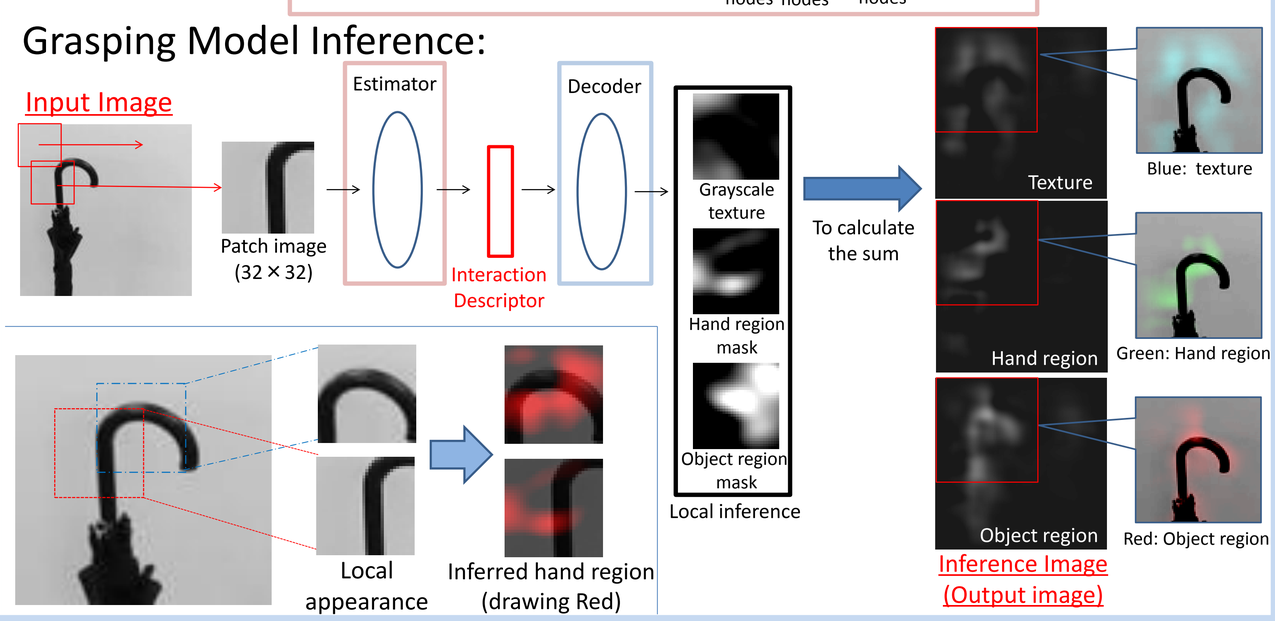
Auto-Encoder:



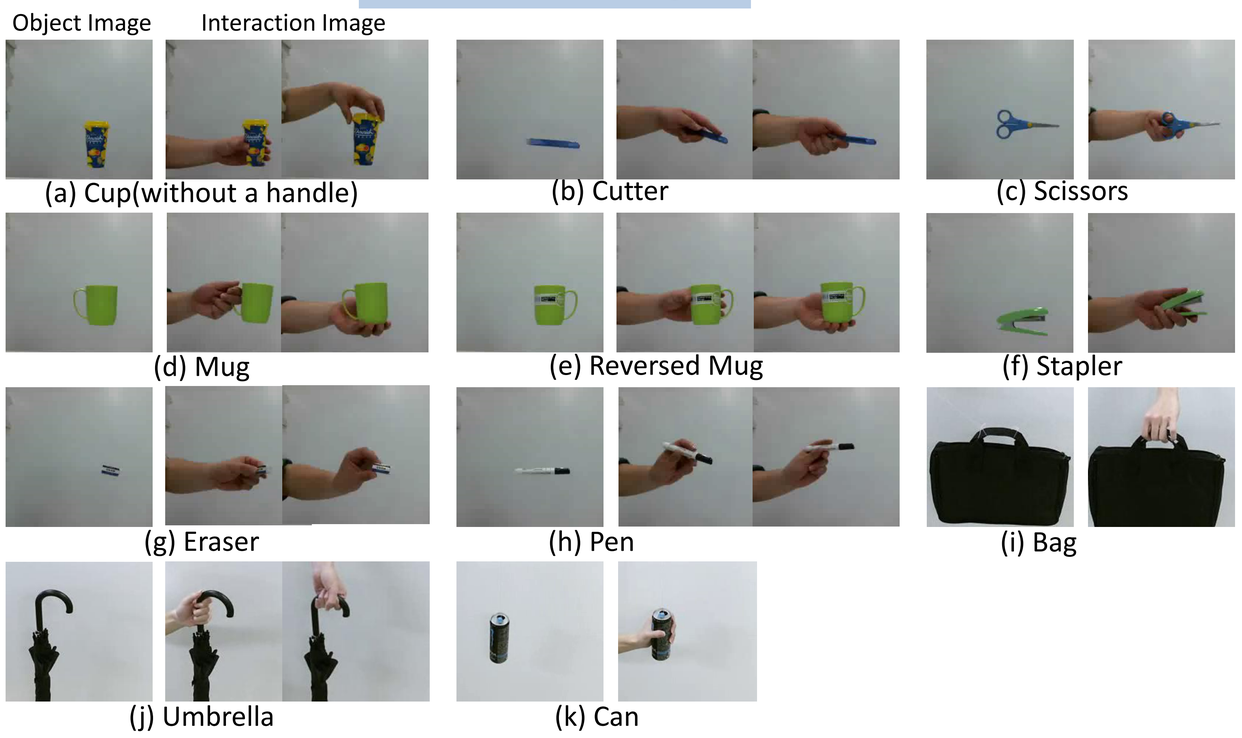
Interaction Estimator:



Grasping Model Inference:

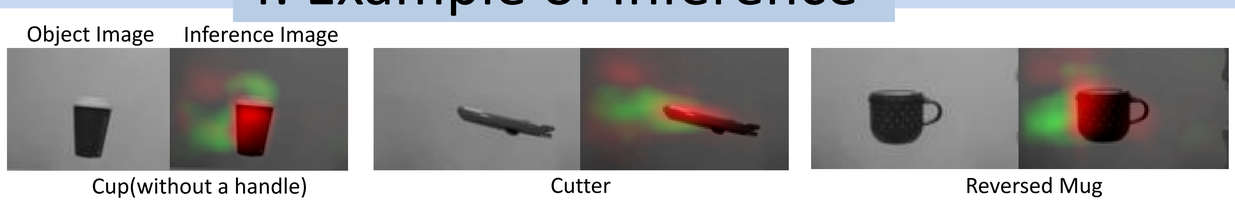


3. Training



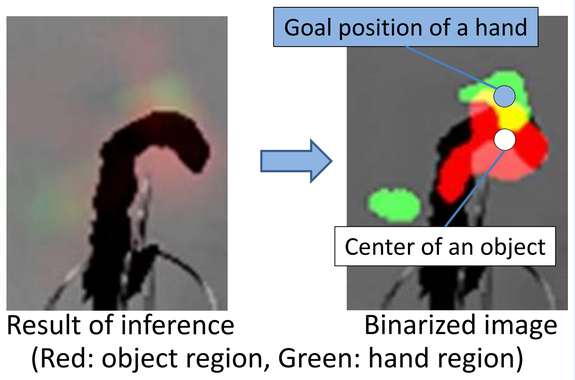
- Training the model by using 2160 images which include 18 types of interactions.

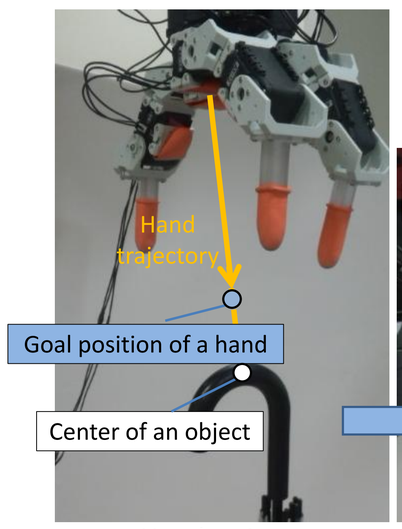
4. Example of Inference

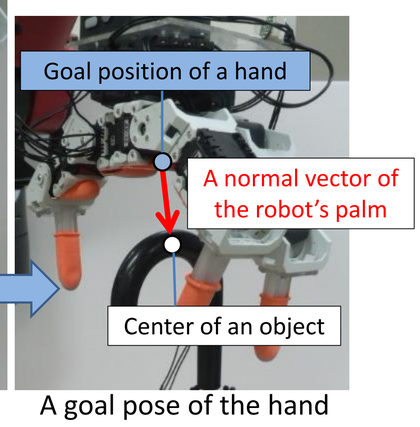


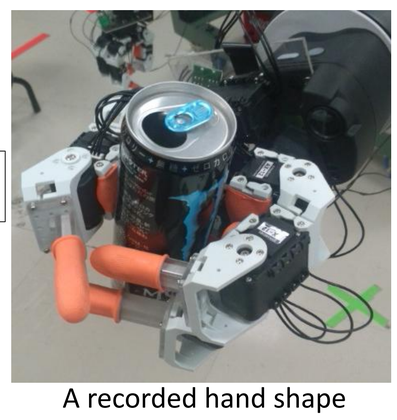
5. Grasping Based on the Inference

- To binarize the inferred object region mask and the inferred hand region mask based on threshold values.
- To calculating the center of gravity in the maximum area.





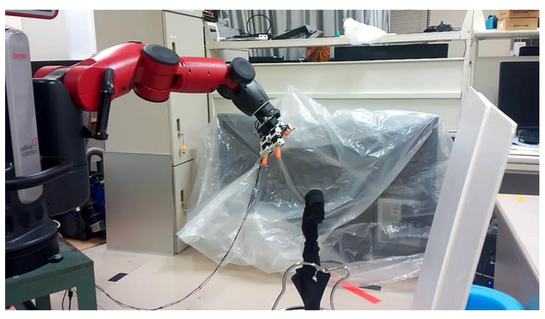


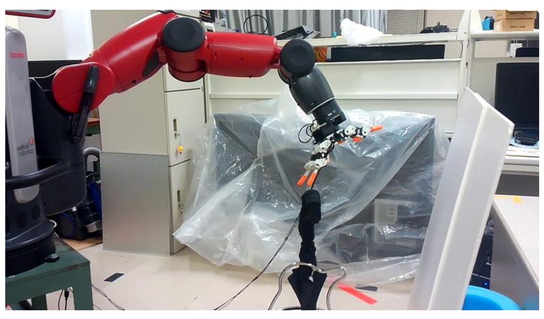


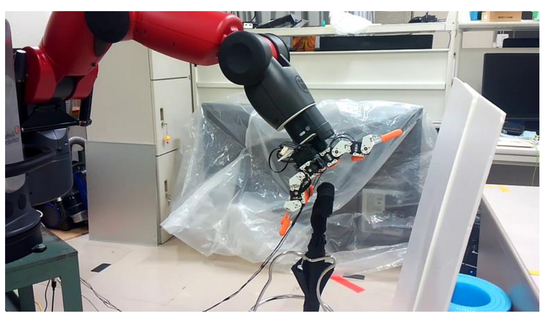
- The pose of when a normal vector of the robot’s palm faces the object center is the goal.
- Recording a hand shape of grasping a can and replaying it after the hand arrived at the goal.

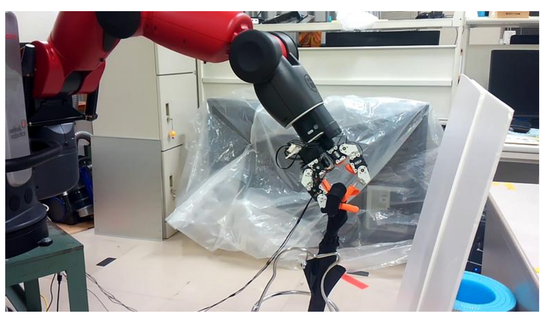
6. Experiment of Grasping

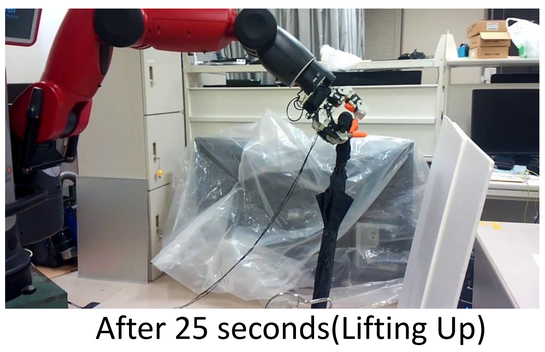
- An umbrella puts into an umbrella stand.
- The distance from the robot to the umbrella is 70cm.
- Because of getting the depth easily, we wind a cloth onto the handle.

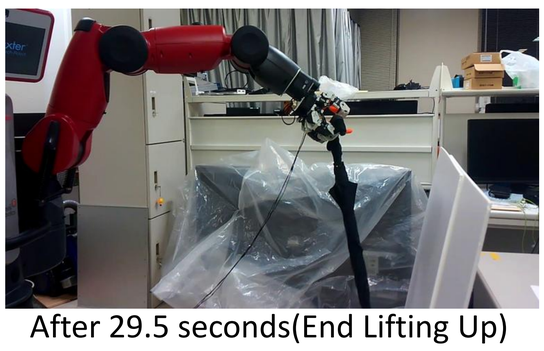












7. Conclusion and Future Work

- We proposed the method that enables a robot to grasp an object based on the object appearance.
- In the experiment, the robot can lift up the umbrella without dropping.
- In future work, we will infer a hand shape when a human grasps an object.

Acknowledgment

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