

Perception and Control

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RoboHow Kick-Off, March, 12-13th, 2012, TUM

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March 12, 2012



More Perception than Control

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Multi objective control in Dual Arm Tasks

Objectives

- ▶ Efficiently perform tasks that are *inherently bi-manual*

Holding an object in one hand and clean/paint it with the other

- Avoid singularities
- Avoid (self)-collisions
- ▶ On-line estimation of object properties
 - Sensors integration



"Open Sesame!"
Adaptive Force/Velocity Control
for Opening Unknown Doors

IROS 2012

Y. Karayiannidis, C. Smith, F. E. Viña, P. Ögren, and D. Kragic

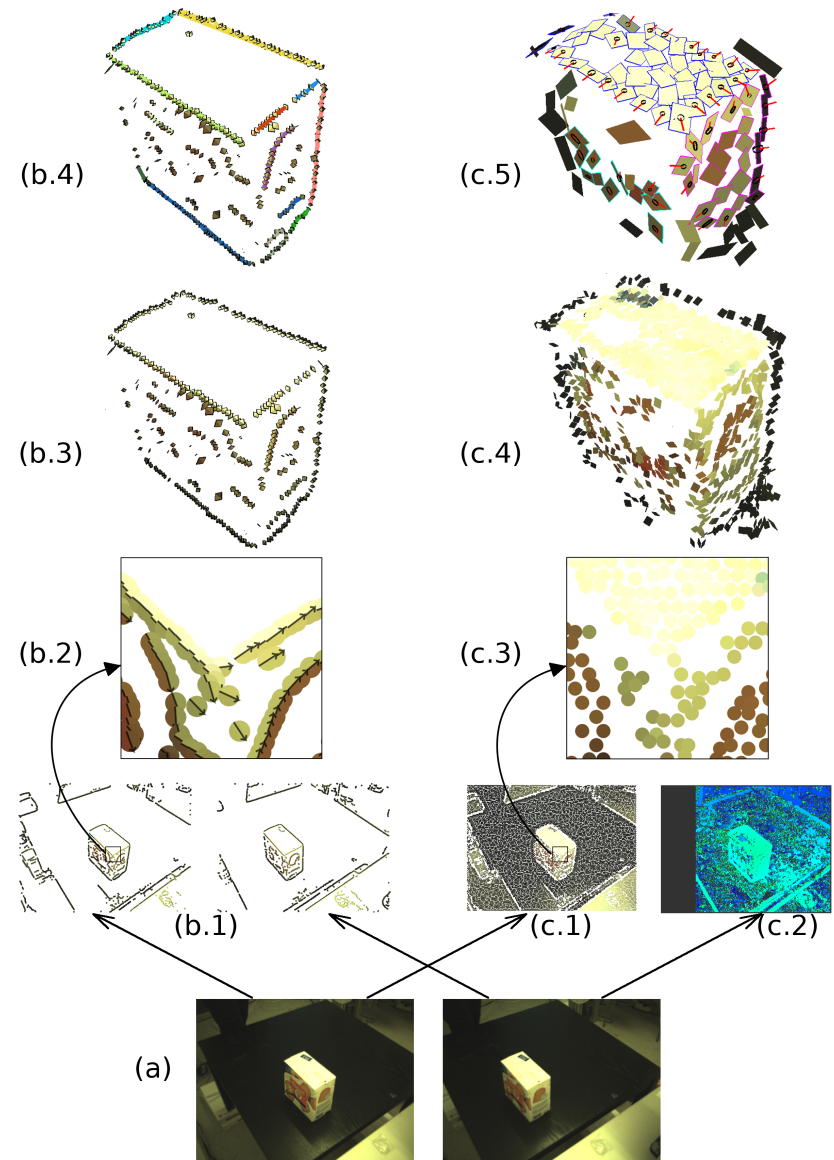
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Scene understanding

- ▶ Object detection
- ▶ Scene/object segmentation
- ▶ Tracking

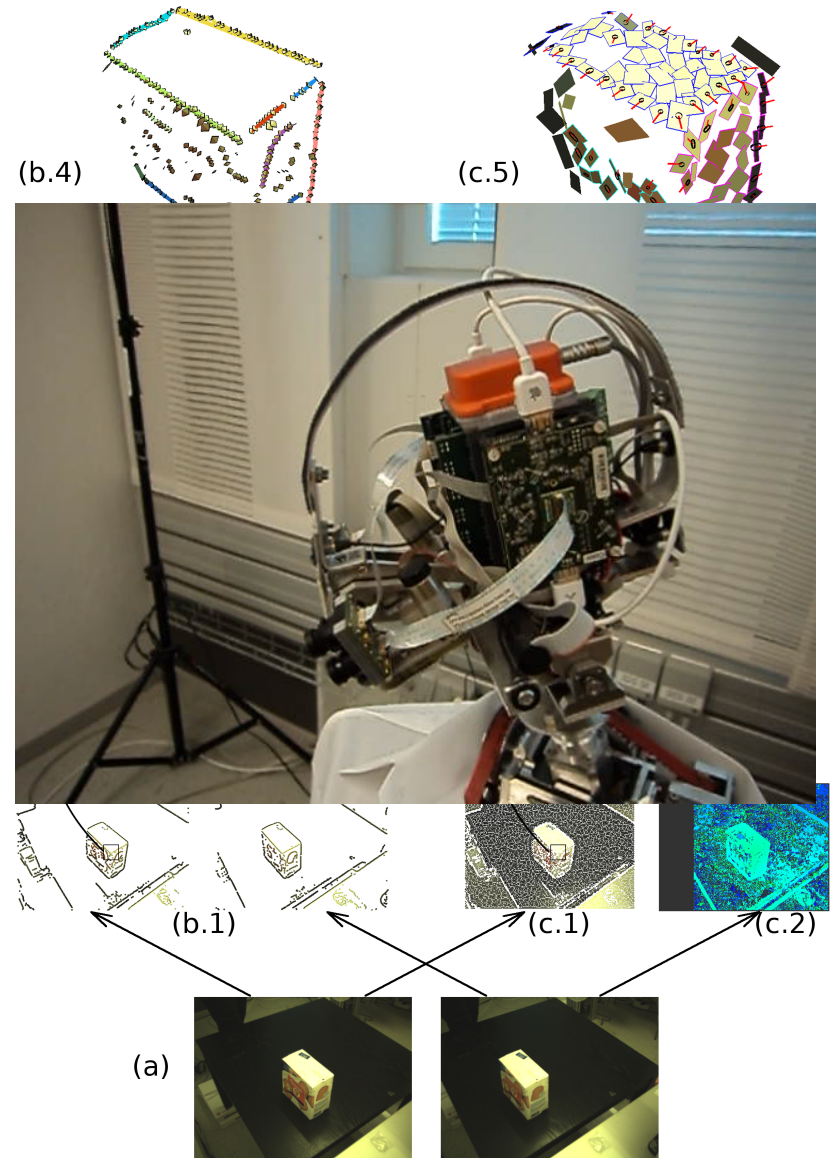
of **UNKNOWN** objects



Scene understanding

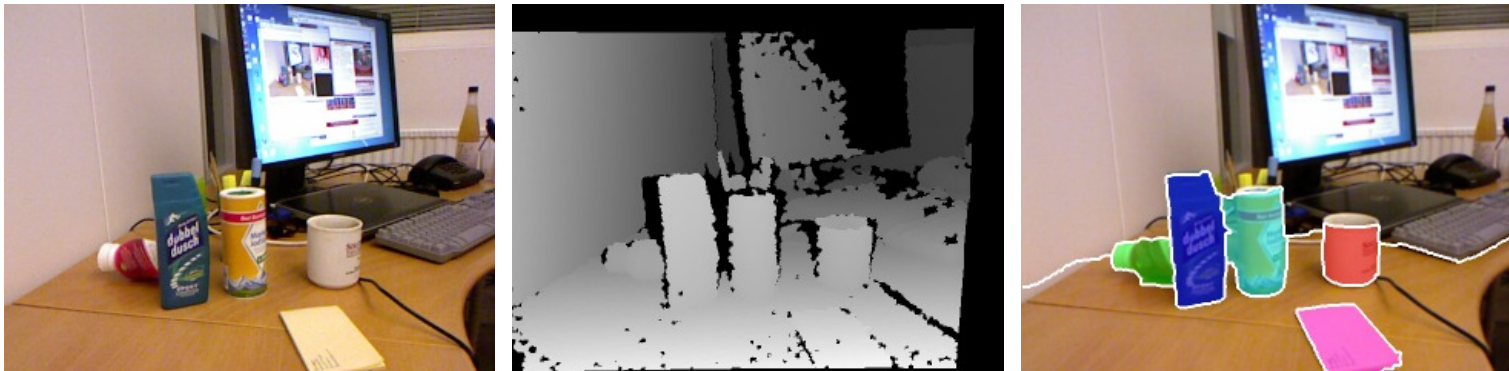
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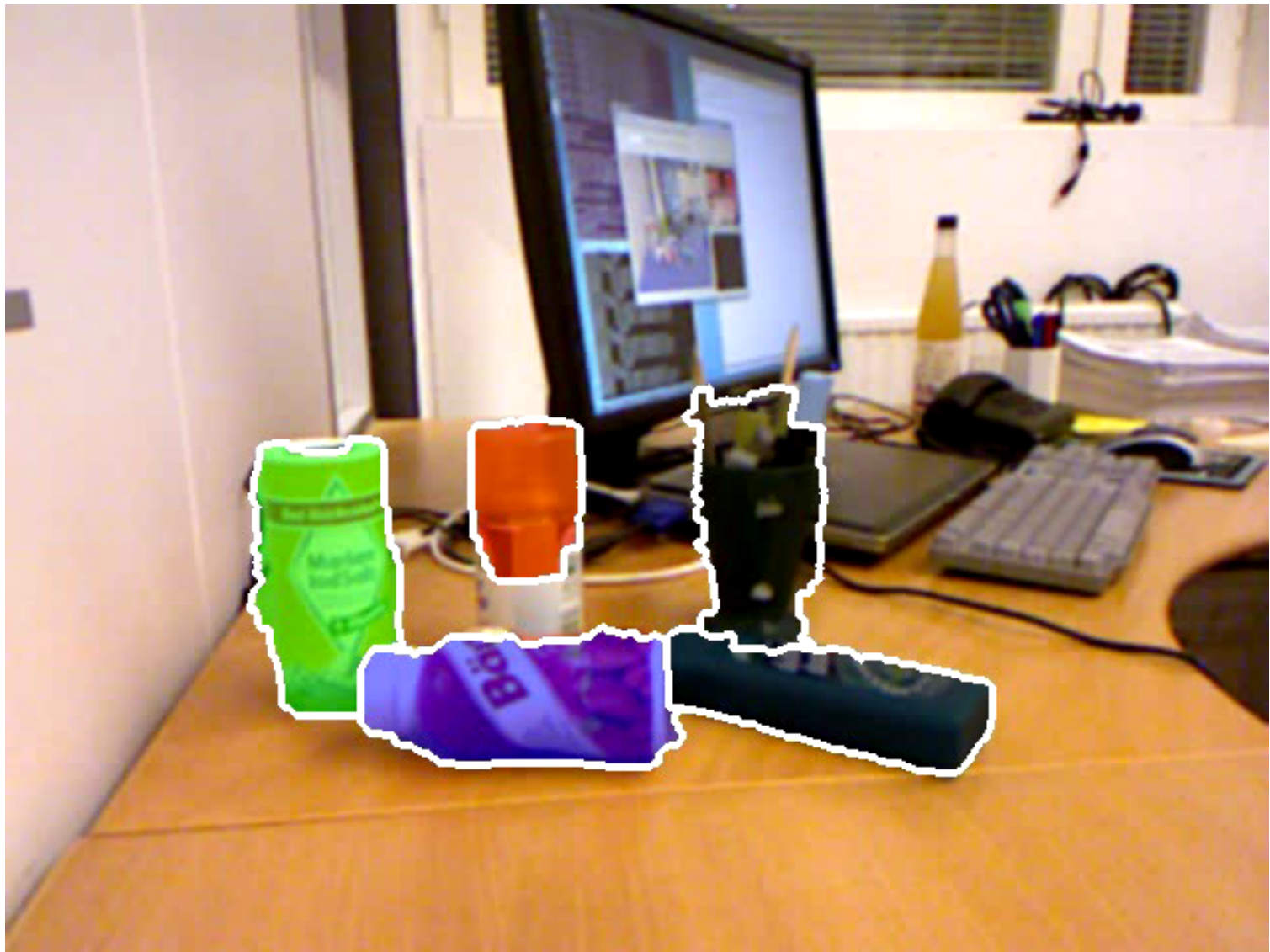


Active control for object/scene segmentation

- ▶ Grouping into objects assumes local similarities in color distributions and 3D positions
- ▶ Solved through MRF inference over image space
- ▶ Exploits temporal consistency (because of movement)
- ▶ Initialised through object seeds from attention



- ▶ Bergström, Björkman, Kragic: Framework for Active Scene Segmentation, In: IROS 2011.



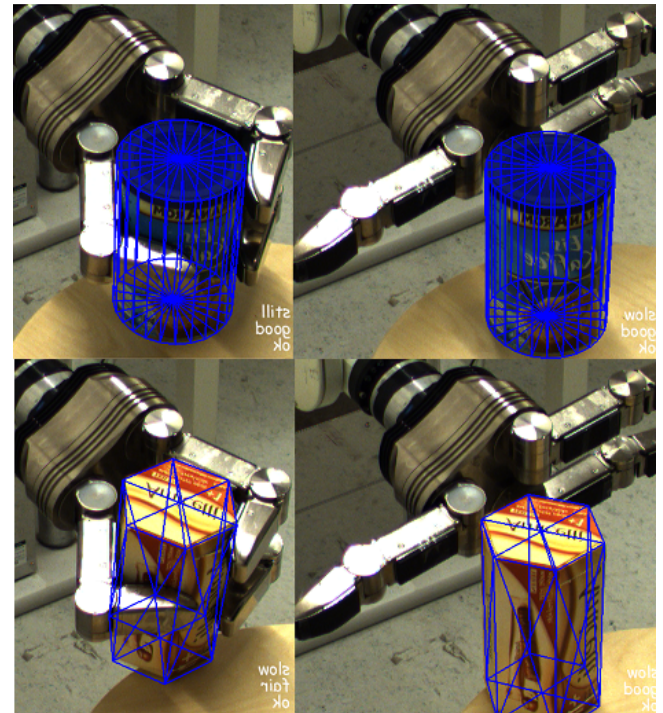
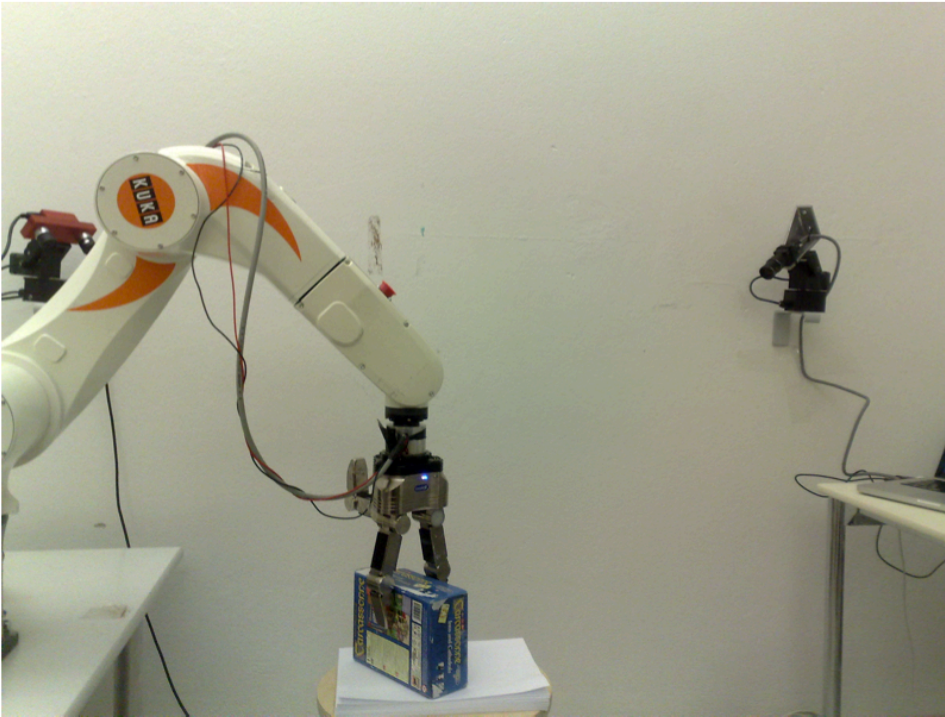
Learning object models through interaction

- ▶ Objective:
 - Test object hypotheses through pushing actions
 - Gradually learn more about the current scene
- ▶ For RoboHow: generate controlled movements after grasping an object (learn shape, weight, ...)



- Bergström, Ek, Björkman, Kragic: Object Disambiguation Using Pushing Actions. In: ICVS 2011

Y. Bekiroglu, R. Detry and D. Kragic. Joint Observation of Object Pose and Tactile Imprints for Online Grasp Stability Assessment. IEEE IROS 2011



The method:

- tracks the pose of a grasped object
- acquires grasp tactile imprints via pressure sensor arrays mounted on the fingers
- optimizes and evaluates models with f- fold cross-validation.

A stable grasp

$P(\text{stable}|\text{vision}) = 0.72$



$P(\text{stable}|\text{touch}) = 0.99$



$P(\text{stable}|\text{vision, touch}) = 0.97$



The method:

- Predicts the stability of a grasp before attempting to lift an object.
- The percepts considered consist of the tactile imprints and the object-gripper configuration.
- Using a kernel-logistic-regression model of pose- and touch- conditional grasp success probability

Learning Tactile Characterizations Of Object- And Pose-specific Grasps

Yasemin Bekiroglu Renaud Detry Danica Kragic

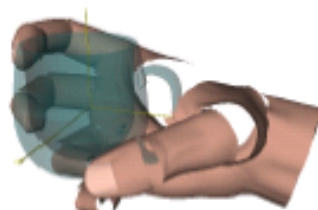
IROS 2011 submission

Multivariate Discretization for Bayesian Network Structure Learning in Robot Grasping

Bad for
Pouring



Good for
Pouring



Bad for
Hand-over



Good for
Hand-over



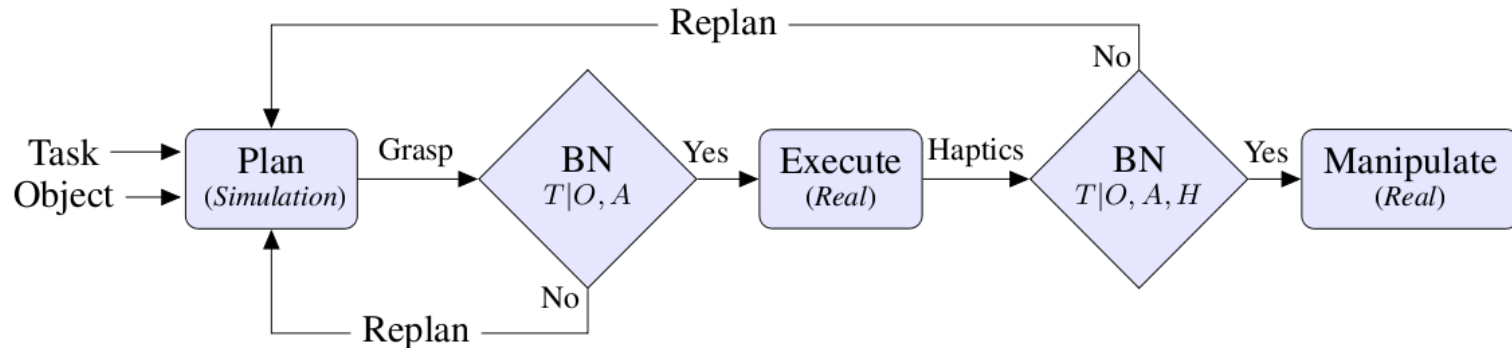
We want a **MODEL OF GRASPING TASKS** that allows:

- ▶ **selecting objects** that afford an assigned task,
- ▶ **planning grasps** that satisfy the task constraints.

We need to model the joint distribution:

$$p(\mathbf{Y}), \text{ where } \mathbf{Y} = \{Y_1, Y_2, \dots, Y_N\} \leftarrow \{O, A, C, T\} \quad (1)$$

Task Based Grasp Adaptation



- The input: “pouring from the detergent bottle”

