GRASP

Emergence of Cognitive Grasping through Introspection, Emulation and Surprise

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Consortium

- KTH, Sweden
- KIT, Germany
- TUM, Germany
- LMU, Germany
- LUT, Finland
- TUW, Austria
- FORTH, Greece
- UJI, Spain
- OB, Austria

Psychology		Robotics						Computational vision						Hand design	
Action control and modeling	Cognitive science	Grasping and manipulation	Control	Humanoid robots	Simmulated environmets	Planning	Learning, novelty, surprise	Active Vision Systems	Dextrous Object Tracking	Scene segmentation	Obejct modeling	Activity Recognition	3D motion and structure	Robot hands	Prosthetic hands
TUM/LMU		UJI UKA KTH TUW	LUT TUW	UKA	UJI LUT	UKA KTH	TUM TUW	KTH	FORTH	TUM	TUW	KTH UKA	FORTH KTH TUW	UKA	OB

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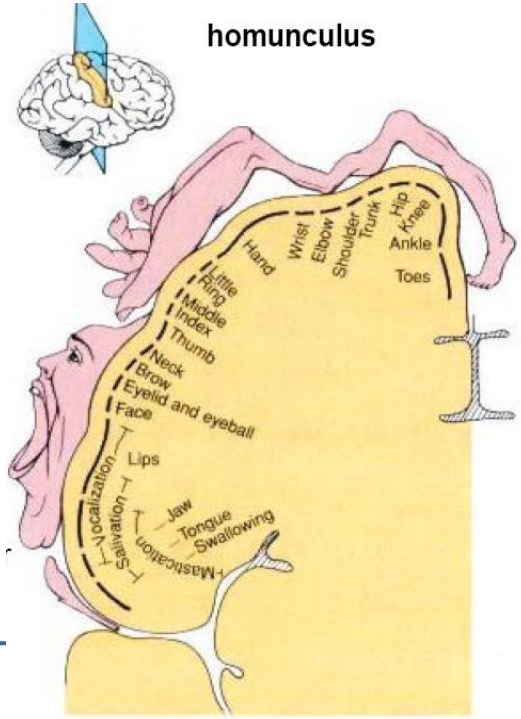
Motivation

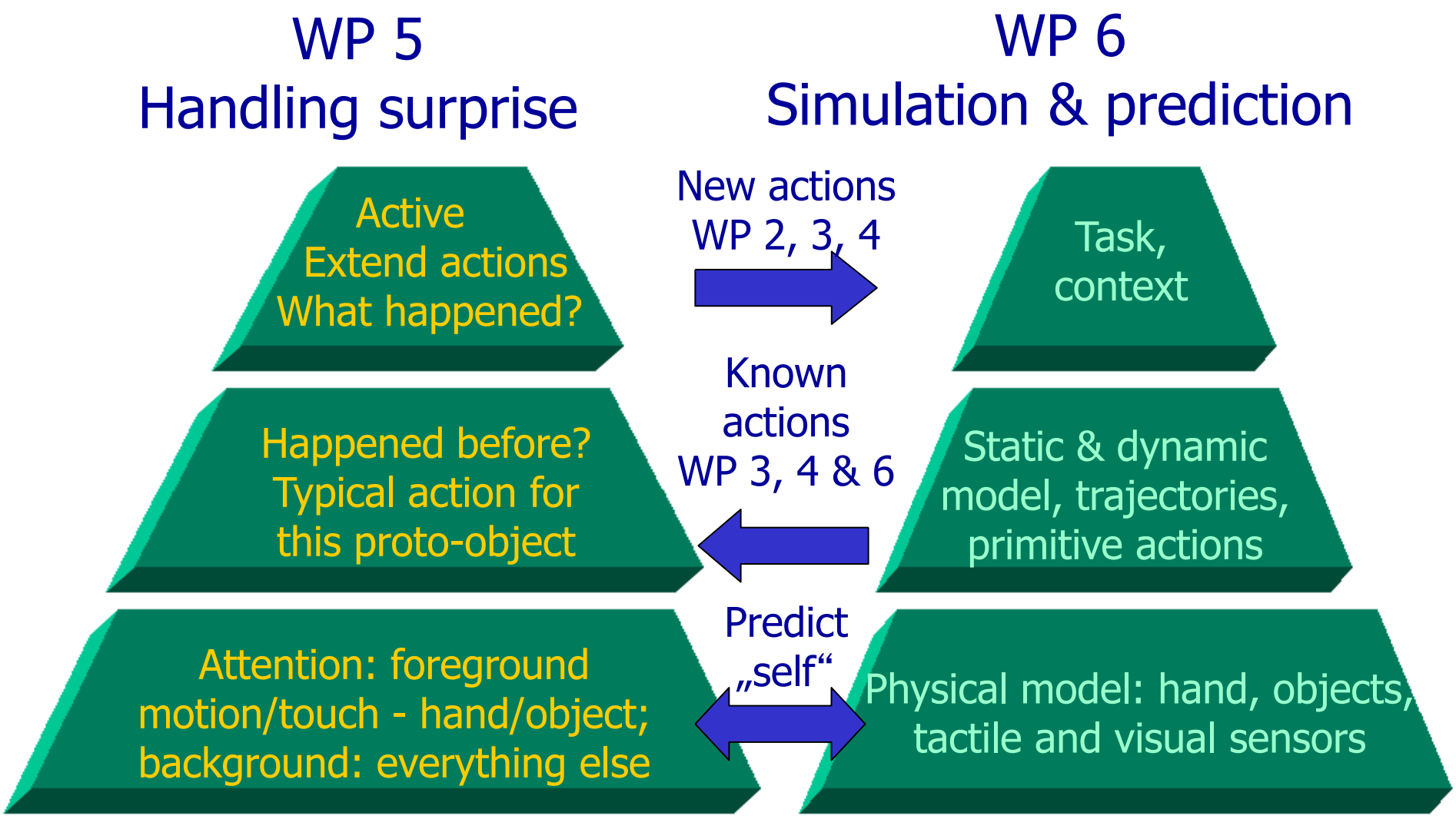
- Grasping and manipulation as a control problem have been studied extensively BUT a gap between detecting, approaching and grasping
- GRASP: cognitive aspects of grasping, implementation and evaluation of system aspects

Objectives

- Theory of grasp modeling
- Self and context-awareness
- Curiosity and surprise driven behavior
- New grasping strategies
- Exploitation and evaluation for prostheses, industrial and service markets



Low (simulate) vs. high (surprise) level

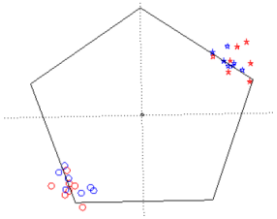


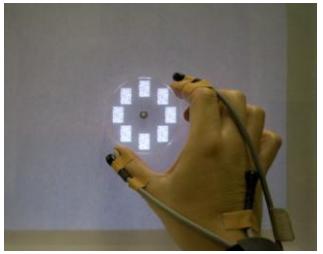
Major achievements

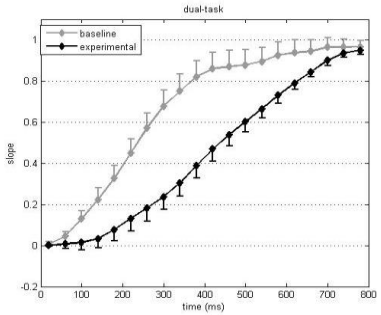
- New insights in vision guided grasping in humans
- Markerless tracking of articulated hands
- Machine learning methods for comparing anthropomorphic hands
- Grasp stability and object properties estimation based on multisensory data
- Categorization for task based grasping
- Surprise driven scene understanding
- OpenGRASP
- Benchmarking suite

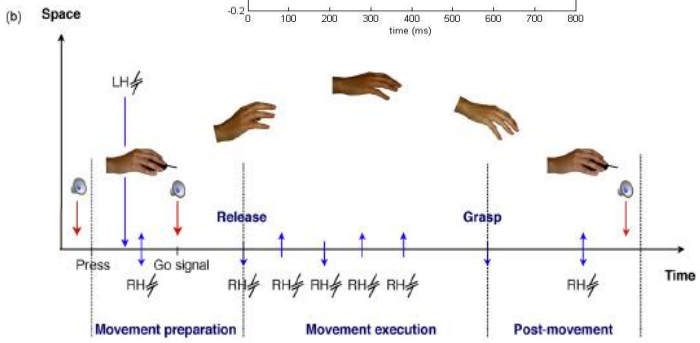
Human grasping - LMU

1. Grasp point selection with different approach directions
2. Cover attention and eye fixation behaviour during grasping
3. Attention distribution with tripod grasps
4. Visual attention and grasp kinematics
5. Tactile enhancement and suppression during reach-to-grasp movements









CogSys
Cognitive Systems

Tracking the articulated motion of hands

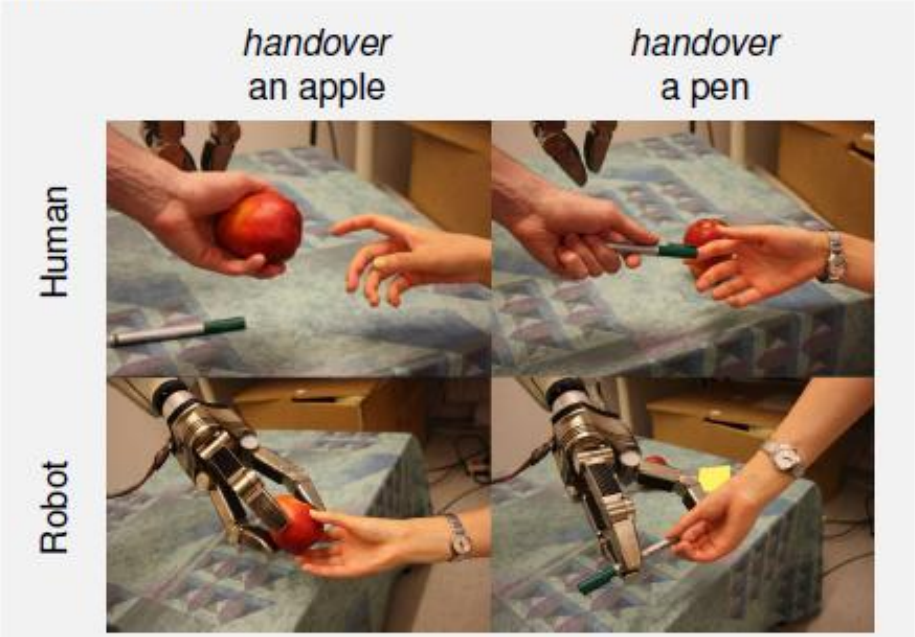
FORTH

What is a good grasp?

- Integrated probabilistic framework for:
  - Action recognition
  - Task based planning
  - Grasp stability assessment

Embodiment-Specific Representation of Robot Grasping using Graphical Models and Latent-Space Discretization, D. Song, CH Ek, K. Huebner, D. Kragic, In *IEEE/RSJ IROS 2011*

If the task is:



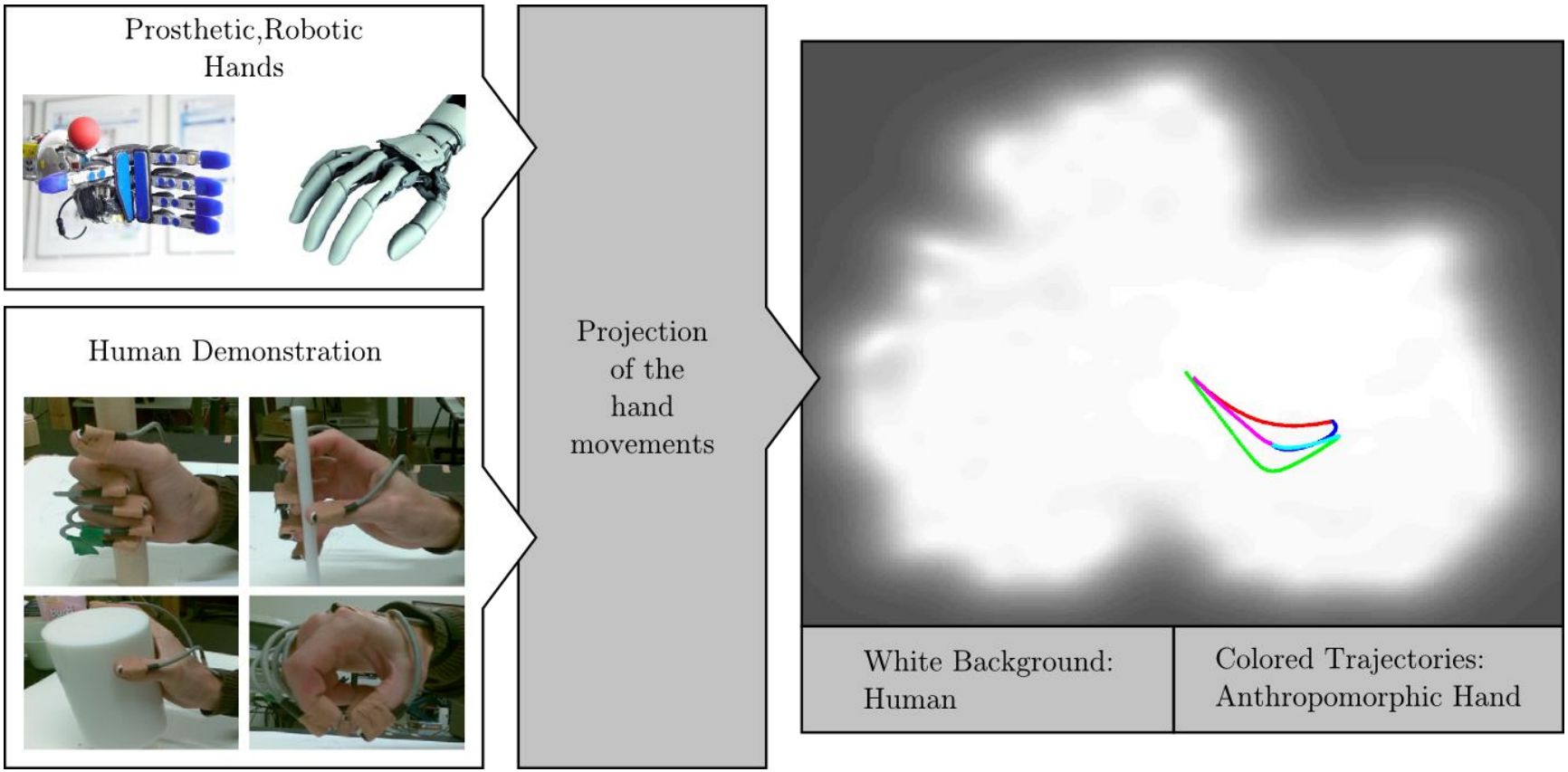
Problems:

1) How does a post-grasp action (or task) constrain which object to use, and how to grasp it? Greeno (1994)

2) How to transfer this task knowledge across different embodiments? Alissandrakis *et al.* (2007)

3) What can be the role of human teacher in task constraint learning? Calinon and Billard (2007)

Comparing human and robot hands

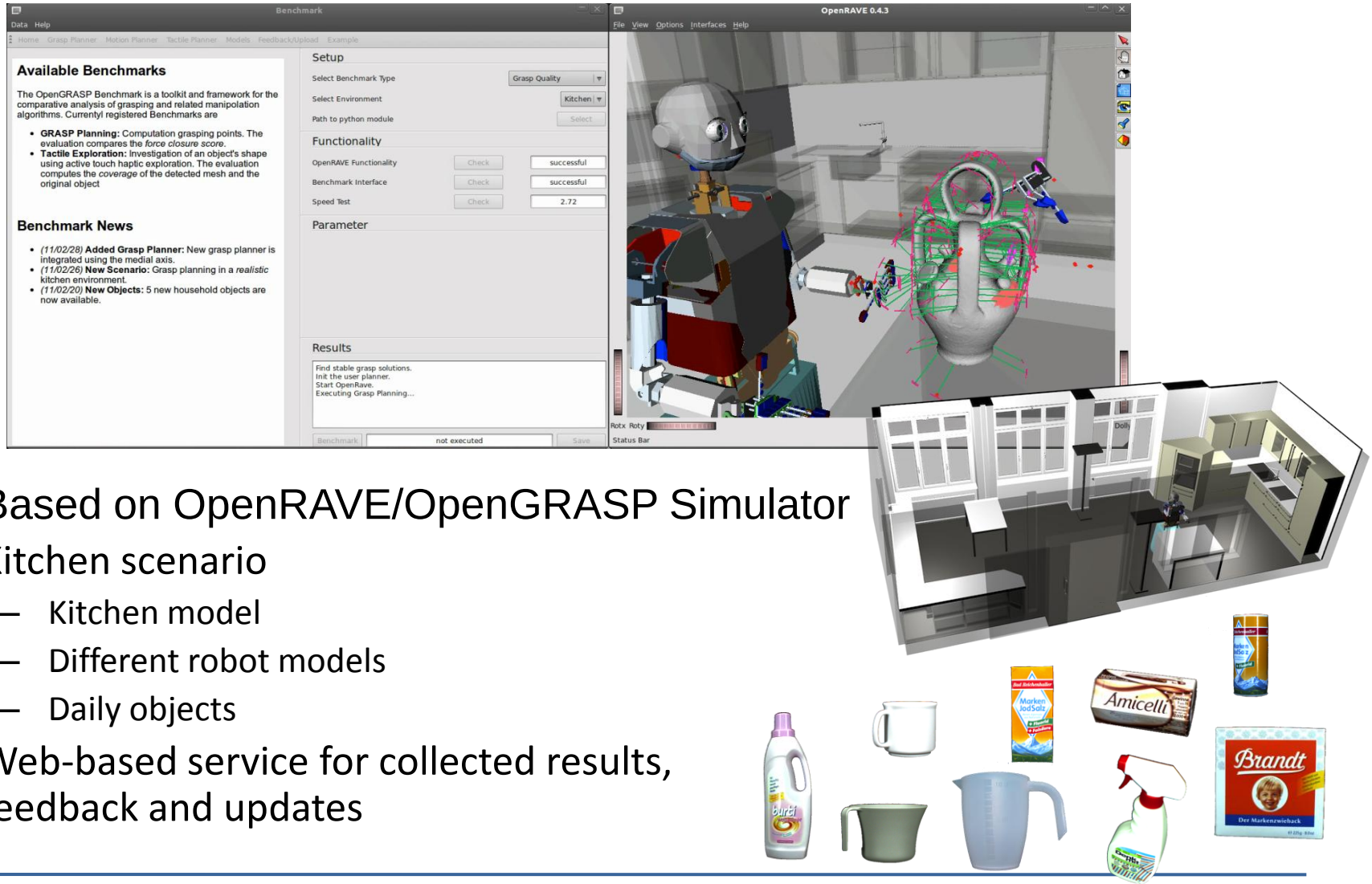


T. Feix et al. (2012)
Viszualization of Anthropomorphic Hand Performance
Cond acc Transactions on Robotics

Software tool as grasp reasoning engine:

- Visualize the current foreground/background knowledge.
- Replicate the observed actions that have been mapped to the robot particular embodiment.
- Plan and reason about different hypothesis.
- Dynamic simulation and prediction of sensor perception.

Benchmarking environment



- Based on OpenRAVE/OpenGRASP Simulator
- Kitchen scenario
  - Kitchen model
  - Different robot models
  - Daily objects
- Web-based service for collected results, feedback and updates

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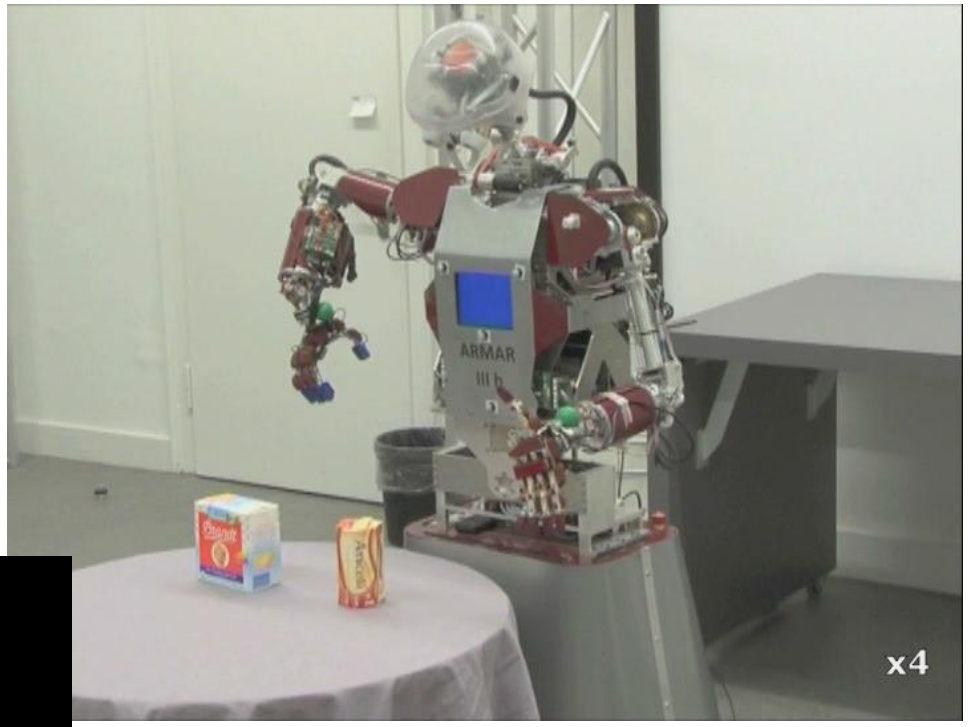
Visuo-haptic grasping



Emptying the box using blind haptic manipulation primitives

Javier Felip, José Bernabé and Antonio Morales
Robotic Intelligence Lab - Universitat Jaume I
Castellón, Spain.

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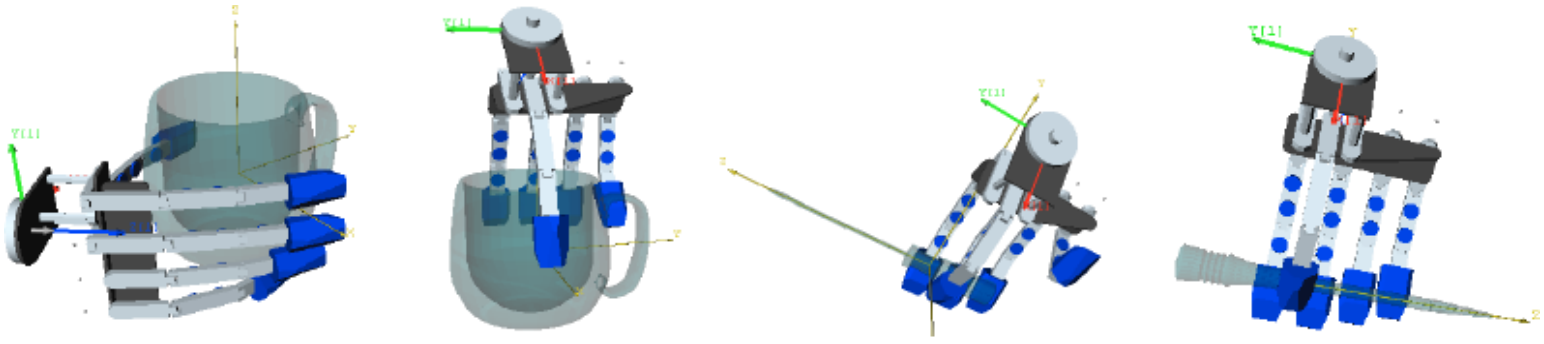
Task-oriented grasping

- Goal: „Robot bring me a tool”,
  „Robot bring me something to drink from”
- Grasp depends on an object CATEGORY and TASK



(a) *pouring* (b) *hand-over* (c) *tool-use* (d) *hand-over*

- Information about an object CATEGORY allows to:
  - choose an object that affords the assigned task
  - TRANSFER grasp knowledge between objects that belong to the same category

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