ICRA 2010 Mobile Manipulation Challenge

Matei Ciocarlie

University of Bonn
Willow Garage
University of Koblenz-Landau
Fraunhofer IPA
Intel Seattle / U. of Washington

Intel Labs Pittsburgh
Intel Labs Seattle

Robot Challenge Chairs: Bill Smart, Mark Yim

Where are we?

- State-of-the-art is difficult to gauge, partly due to
  - task complexity
  - hardware requirements
  - etc.

- How do we collaborate?
  - “building blocks” [Brian Gerkey]
  - “hierarchical reusability of skills” [Oliver Brock]

- How do we get beyond “proof-by-video”?

Challenge Overview

- Goals
  - hands-on experience with real platforms
  - standardized environment (and task)
  - encourage collaboration and dissemination of ideas

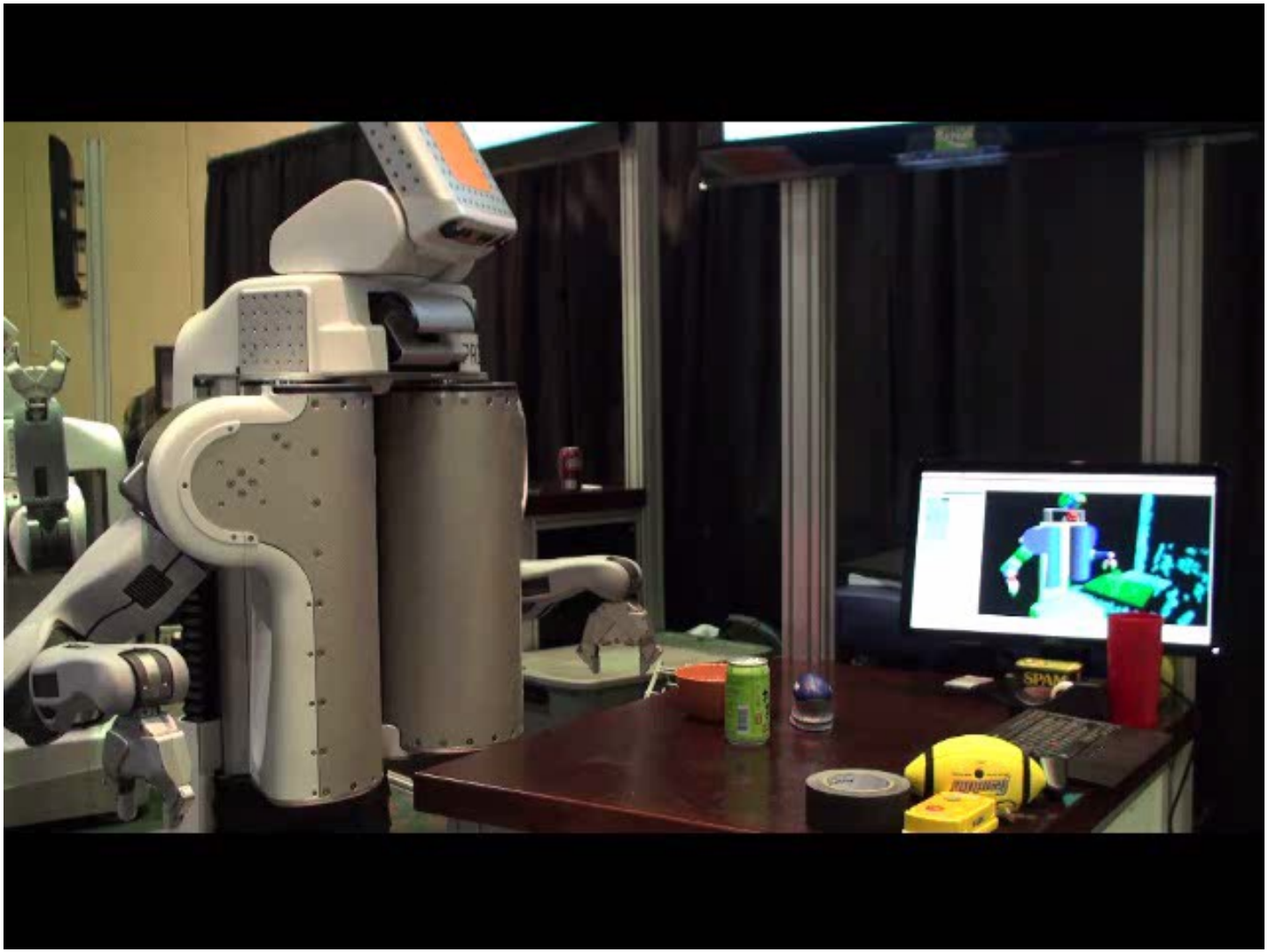
- High-level task descriptions
  - “**challenge**”, not “competition”
  - object retrieval and tabletop manipulation
  - Manipulation Open

University of Bonn

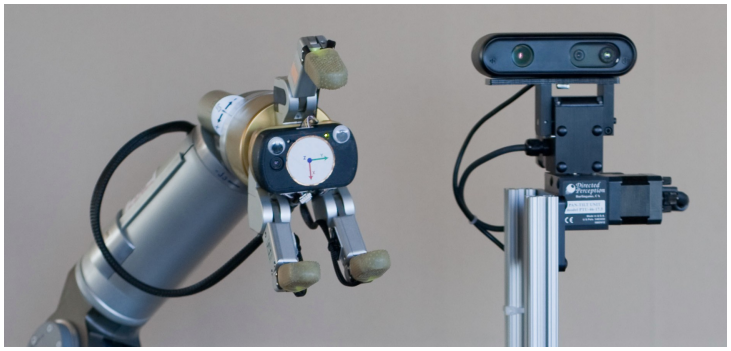
Fraunhofer IPA

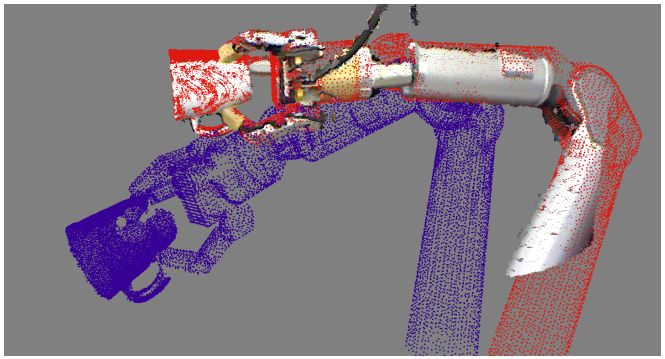
Team homer@UniKoblenz

Willow Garage



University of Washington / Intel Labs Seattle

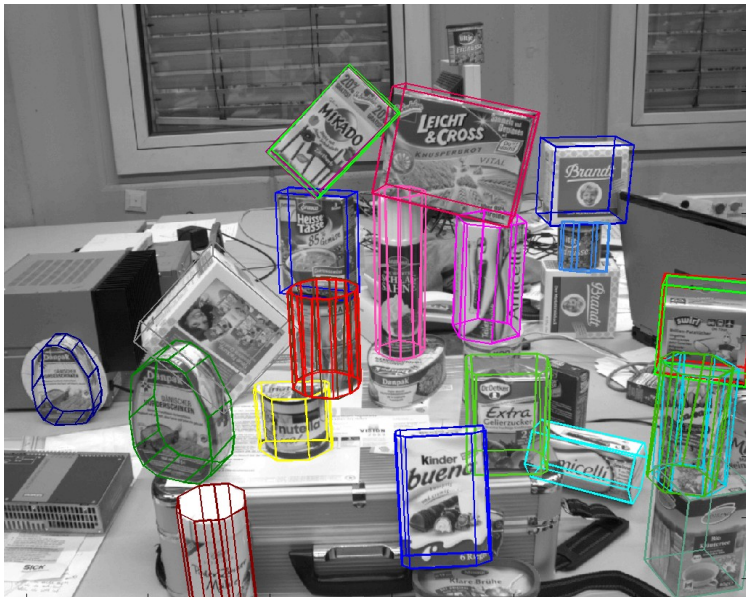




Manipulator and Object Tracking for In Hand Model Acquisition,
Michael Krainin, Peter Henry, Xiaofeng Ren, and Dieter Fox

What have we done?

Fraunhofer IPA

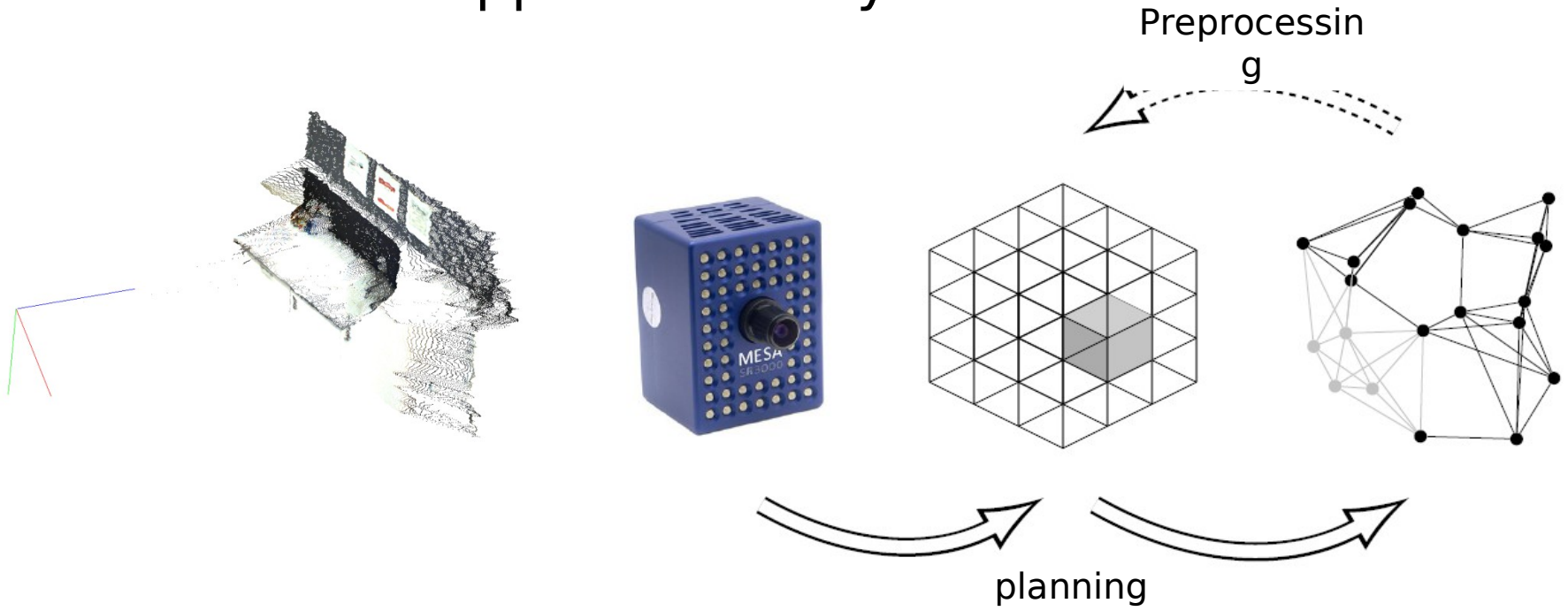


- Database of more than 100 objects (texture, 3D mesh) including
  grasp table for different grippers (Schunk SAH, SDH)
- Modeling center at FZI, Karlsruhe, Germany
- Available through: http://wwwiaim.ira.uka.de/ObjectModels
- 6D – pose recognition for objects in database

DESIRE Deutsche Servicerobotik Initiative

Fraunhofer IPA

PRM-based approach for dynamic environments



- Grid-based obstacle map from 3D environment model generated from associated point clouds
- Grasp planning based on grasp table and 6D-pose of object
- Consideration of static objects of the environment and dynamic obstacles for motion planning based on obstacle model

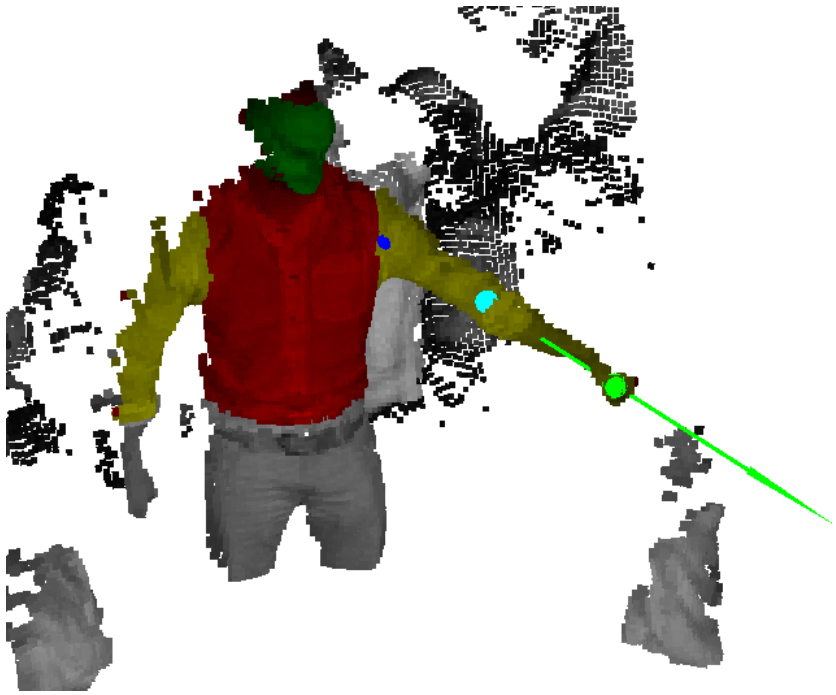
Team homer@UniKoblenz

- **How to clean up a toddler's playground:**
  - Systematic exploration of unstructured environment
  - Mixed 2d/3d environment model built from sensor data
  - Cooperation of two different manipulators for picking up objects from the floor

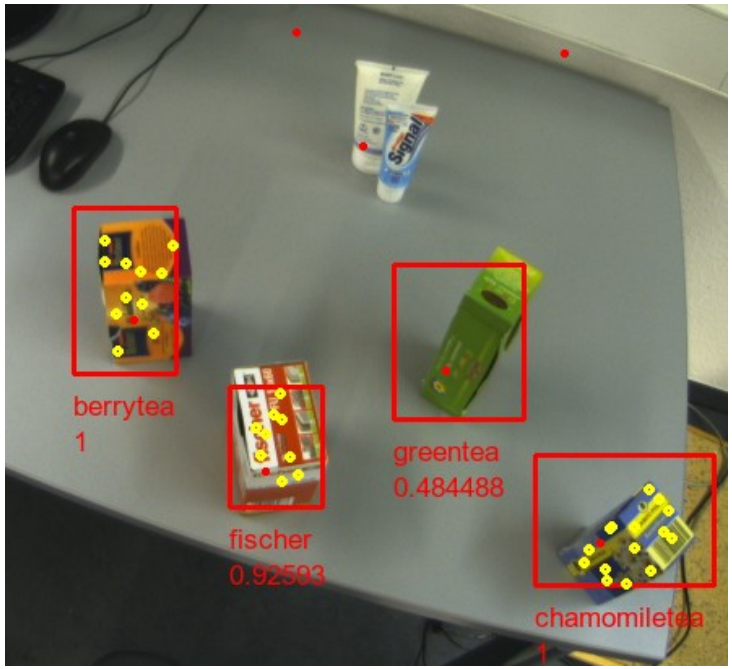
NimbRo Team (University of Bonn)

Recognition of Pointing and Showing Gestures

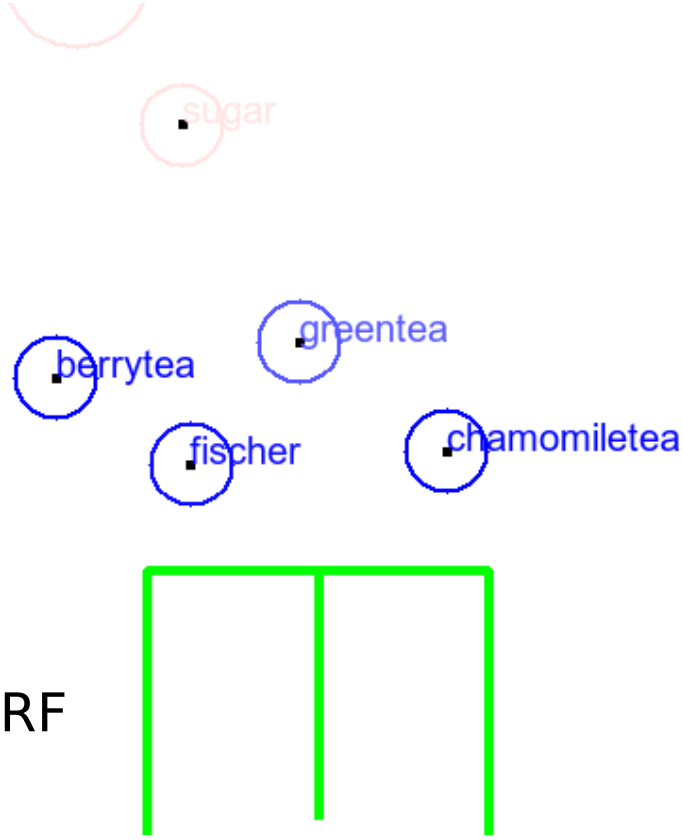
- Based on ToF-camera
- Starting from detected faces
- Segmentation of shown object



NimbRo Team (University of Bonn)



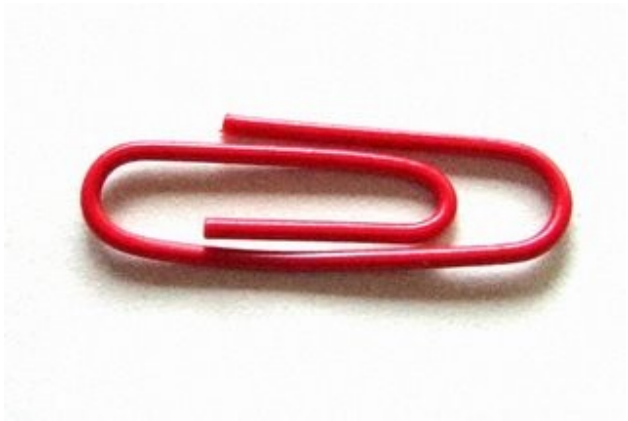
Visual Object Recognition



- Detect objects with laser / ToF-camera
- Map them to image plane
- Recognize them using color and SURF features
- Kalman filter for objects

Where are we going?

Team homer@UniKoblenz



- **Open questions:**
  - Manipulation of very small, large, flat and non-rigid objects with the same manipulator(s)
  - Manipulation of objects that are close to each other (e.g. piled-up stuff)

Fraunhofer IPA

- Intuitive User-Interaction
- Safe Manipulation in human environments

- Adaption and Learning (w.r.t objects, unstructured environments)
- Distributed Development and integration
- Affordable Robotics Hardware

How do we measure progress?

Mobile Manipulation – Sharing Results

- One way to come together over
  - different environments
  - different task specifications
  - different hardware platforms