What’s been keeping me busy?

- Milestone 2
  - Far outlet detection
  - Door handle detection
- Tabletop object detection
  - 2D Chamfer matching
  - 3D Model fitting
- Integrating FLANN in OpenCV
- PR2 Challenge
Far outlet detection

- Uses the stereo camera and base laser to identify location and 3D pose of power outlets
- Outlet candidates obtained by segmenting the disparity image
- Wall pose computed from the base laser scan
- List of outlet candidates is filtered using position, size and orientation priors
Far outlet detection

- Outlet candidate patches are rectified to obtain a frontal view
- Outlet identity is confirmed using a template matching algorithm
Door handle detection

- Initial detection using a boosted cascaded classifier of haar features
- False positives eliminated using position and size priors
- Detections clustered across several frames for increased robustness
- 3D location of handle from stereo
Manipulating tabletop objects: one of the main tasks of a robot in a household environment
- Setting/cleaning the table
- Serving drinks

Usual tabletop objects are difficult (no texture, transparent)
- Techniques based on local features fail
Ikea objects dataset
2D Chamfer matching

- Approach for finding the best match of a contour model to an edge image
- Contours can be strong indicator of object’s identity
2D Chamfer matching
Grasping of delicate (glass) objects requires precise object localization
- Just a bounding box around the object is not enough
- We must also know the grasp location for a specific object

Extended the 2D chamfer matching approach to 3D
3D model fitting

- Two stage approach
- Bottom-up object localization
  - Determines probable object locations
  - Table plane detection and removal
  - Point cloud clustering
- Top down model fitting
  - Determines exact object pose and identity
  - Find the model with the best correspondence to the point cloud
  - ICP-like (Iterative Closest Point) algorithm
3D model fitting

- “tabletop_objects” package
- The 3D model fitter determines
  - Object identity
  - Object pose
  - Grasp pose
  - Object mesh - used in the planing stage for a more precise collision map
- Integrated with the planing pipeline
PR2 challenge

- Applied the 3D model fitting approach for detecting juice/watter bottles
- Used the tilting laser point cloud (much more sparse than the laser point cloud)
Model capture
Integrated FLANN in OpenCV
- FLANN - Fast Library for Approximate Nearest Neighbors
- fast nearest-neighbor searching in high dimensional spaces

PR2 teleoperation using a phone
- based on Asterisk open source PBX
- call the robot on the phone and send it to a specific office
- other use cases possible: eg. deliver a message
Work in progress

- Improving bottom-up part of object detection pipeline
  - 3D features voting for object pose
- 3D object tracking
- Neighhorhood indexing for large point cloud structures
  - Sparse voxel grid indexing
  - Benchmarks for the different index types
Thank you!