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Objective Merging cognitive robot tasks using one sensing modality: stereo vision

Obstacle avoidance & navigation: free space detection

Localisation in home environment: free space matching

Object detection: attention around free space & structure recognition

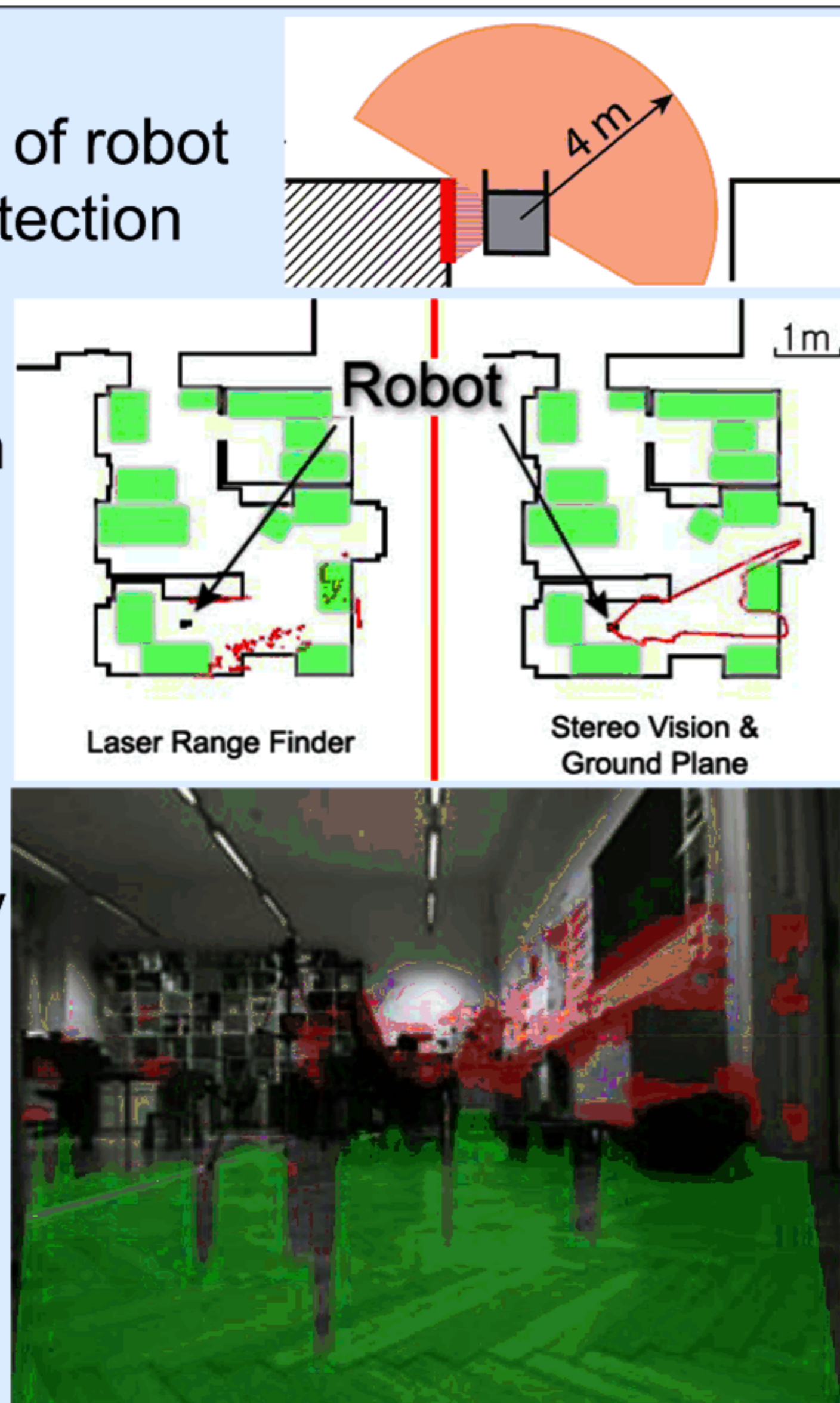
State of the Art Laser sensors – SLAM not useful in home settings: too many unseen objects Different sensors for navigation and detecting object and looking onto tables

Free Space

- Traversable space in front of robot
- Necessary for obstacle detection and avoidance
- Idea: use for localisation
- Contains more information than edge information from laser scans
- Can be also used for limited sensor range

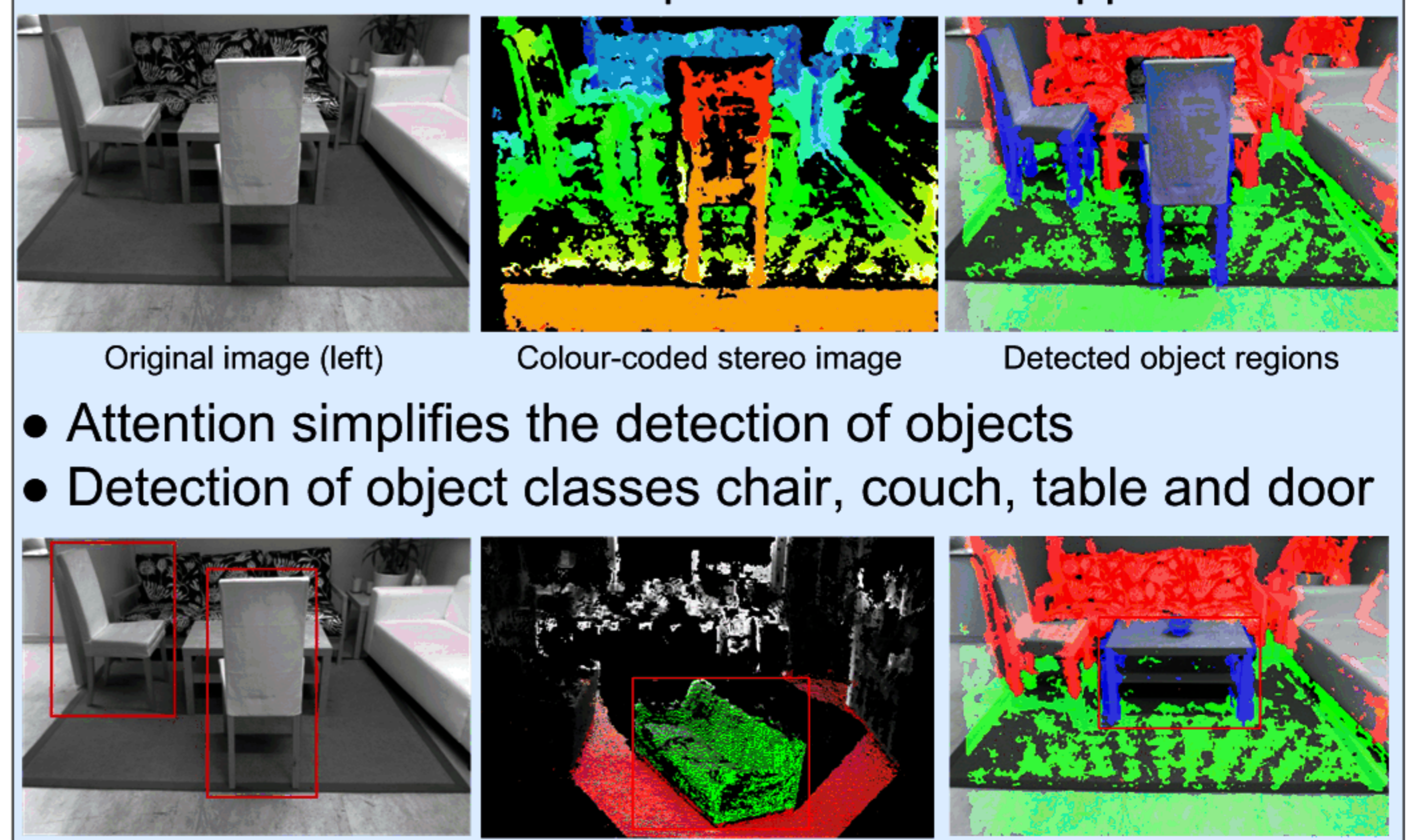
Free space from Stereo:

- Computed from v-disparity and the known geometric set-up robot and camera
- Takes data at all height levels into account
- Projection to ground floor



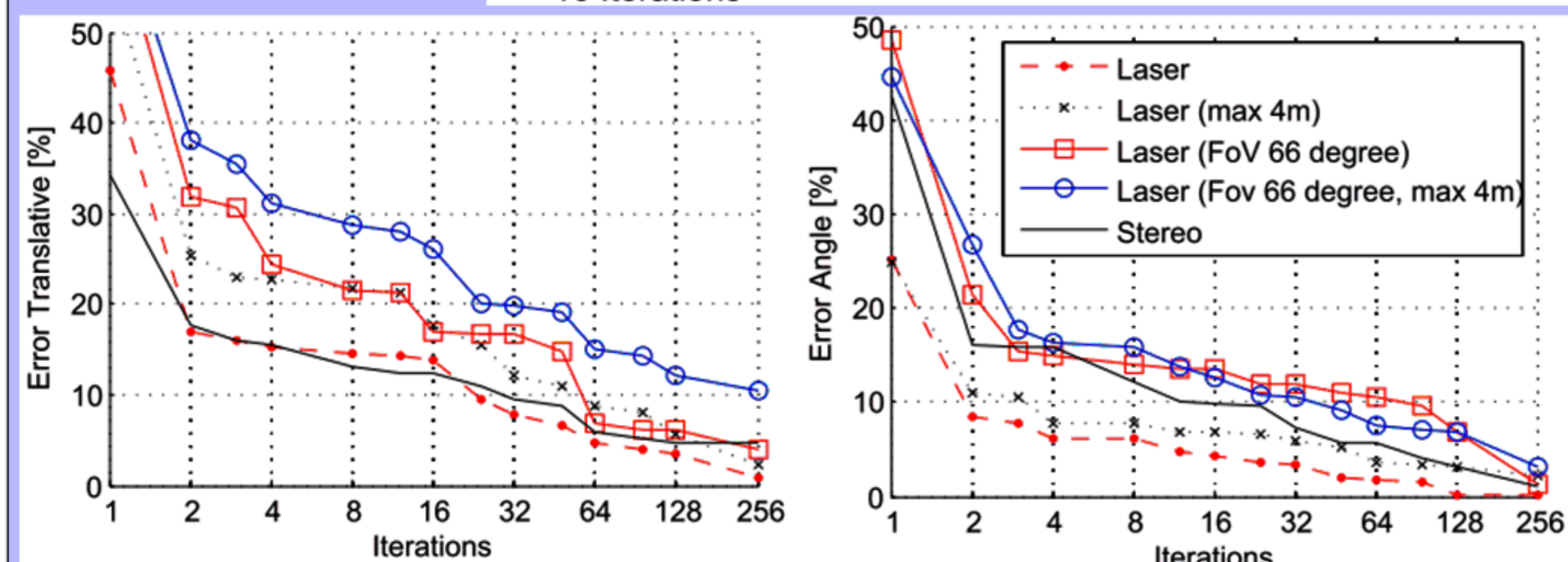
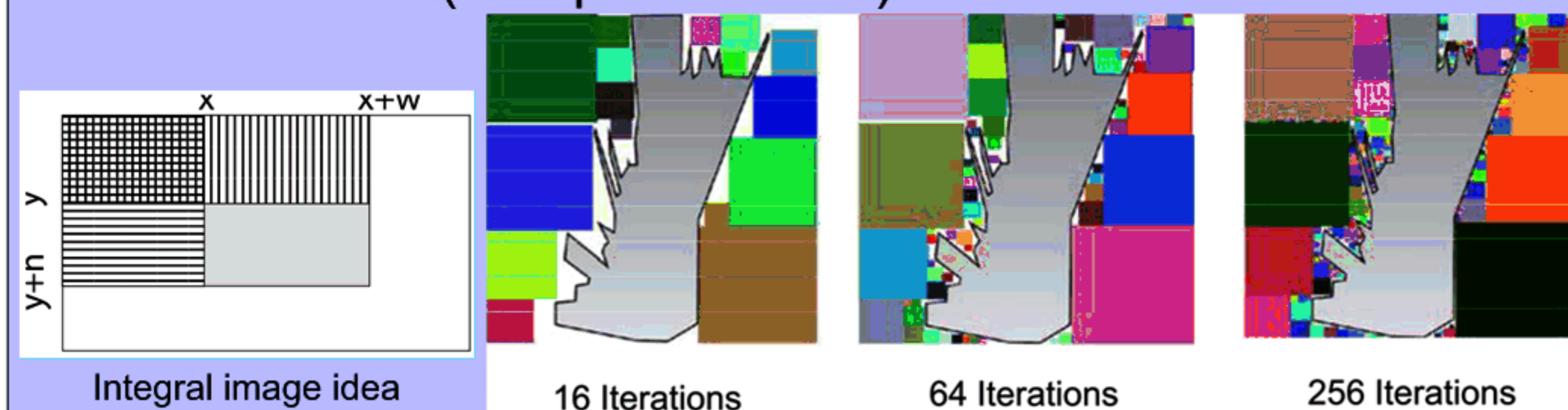
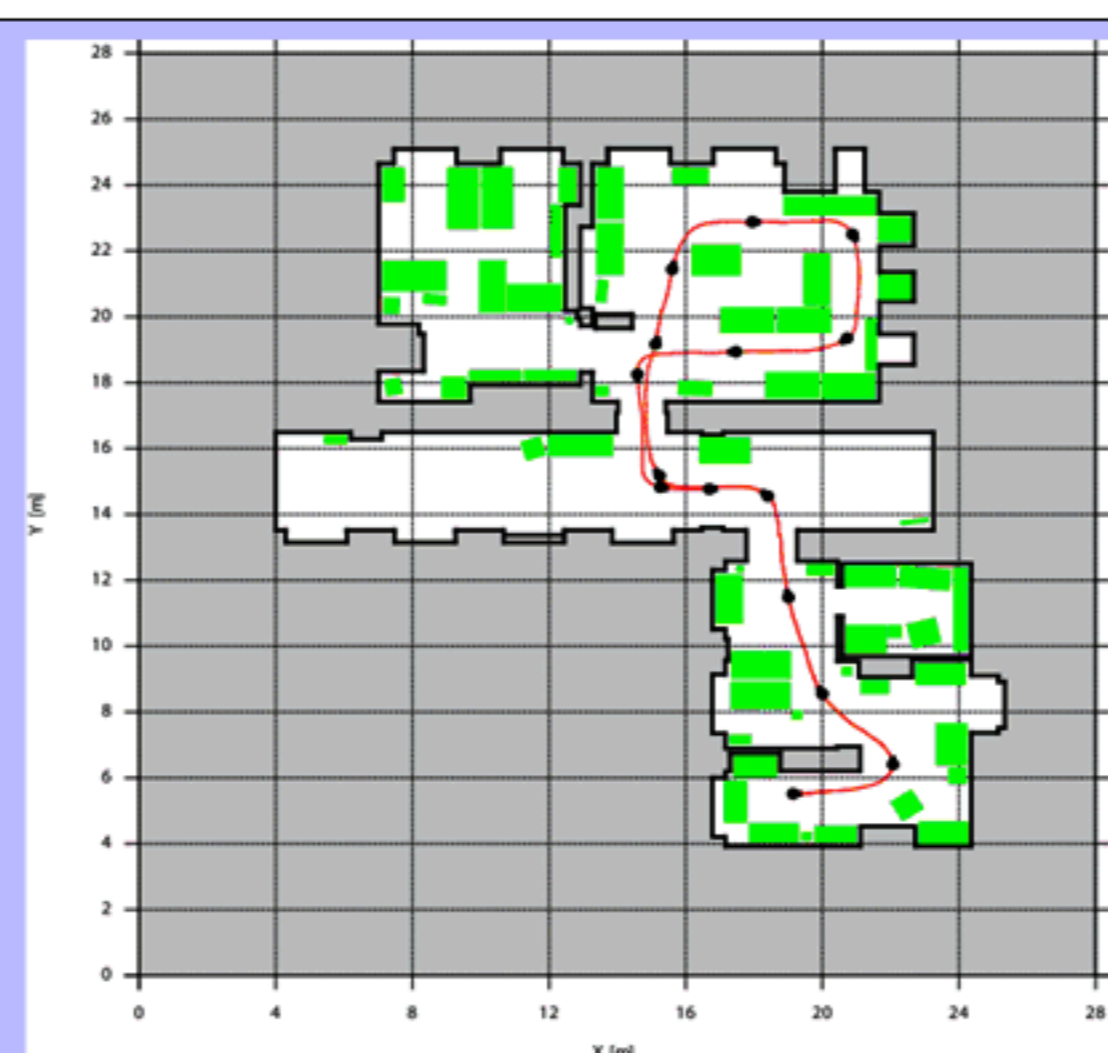
Attention

- Removing ground plane to simplify attention
- Clustering of data into convex bounding boxes
- Exploiting the constraint of expected object size
- Final verification with shape-based or 2D approaches



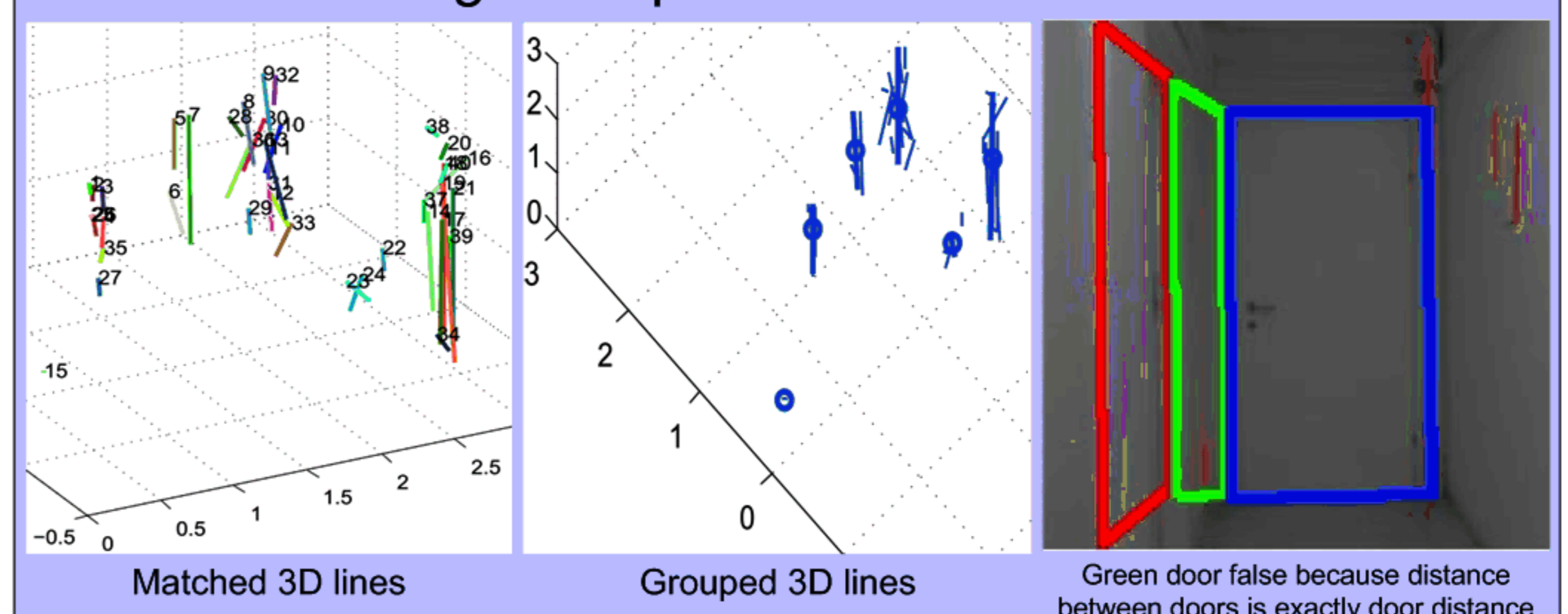
Localisation

- Problem: standard observation model not suited for relatively small field of view of stereo
- Solution: adaptation of model to fit free space
- Computational complexity: fit
- Solution: integral images
64 iterations at 20 Hz on laptop
- Comparison to laser full view and limited field of view
- Localisation as good as with laser, orientation slightly less accurate (see plots below)



Object Detection from structure

- Line-based stereo matching using description or left/right region of lines
Idea: edge complementary to texture
- Matching lines from stereo
- Grouping lines in image to 3D lines
- Door detection from distance: between lines and ground plane constraint using free space



Summary

- Stereo as sensor modality to combine obstacle detection, localisation, and object detection from attention
- Free space as starting point for navigation
- Free space used to guide attention using 3D data
- The combined approach simplifies object detection to attended regions is step towards scene interpretation