RoboCup Rescue 2022
Draft Rulebook
Part 6: Exploration and Mapping

Version 2022-04-14.

History

- 2022-04-16 Added comments (Johannes)

Exploration and Mapping Tests:

5 tests for mapping, object/terrain recognition and detection (all tests are considered for a robot to win Best in Class Autonomy, but only if the tests are performed autonomously).

For all mapping tasks the following rules apply:
- Provide a geotiff in the correct format (see below). We will only accept a single 2D map; if your robot produces multiple maps, provide us with the best one. Turn in the map not later than 10 minutes after you finished your mission.
- Areas mapped in 3D will get extra points. For that provide 2 files: 1) a 3D point cloud either as (pcd) [http://www.pointclouds.org/documentation/tutorials/pcdfileformat.php] or as (Octomap .ot or .bt) [https://github.com/OctoMap/octomap]. 2) provide a slice of a 2D map in geotiff at a height of 2.2m.
- (EXP 1) Map on Continuous Ramps: Create a 2D and/or 3D map of a dark labyrinth while traversing modest ground complexity. This capability has to be an autonomous background service for teleop or autonomous robots.
- (EXP 3) Recognize Objects: This capability has to be an autonomous background service for teleop or autonomous robots. Some items will be multiple times in the maze (e.g. hazmat signs), others rather rare (e.g. door). Show the detection live in the GUI and identify the object e.g. "Oxidizer". Points will be adjusted accordingly (for example, hazmats might get 1 point, doors 5 points). The points are doubled if the identified object is marked at the correct location in the map (within 1 m of the true position). The identified objects in the map have to be numbered and colored according to the standard (see above). There has to be a corresponding text file with the object number, the object type, the time they were found and location. See the file format below.
- Objects for EXP 3 to be recognized in 2022:
  - Fire Extinguisher,
  - Door,
  - Valves,
  - Baby dolls,
  - Live humans (a volunteer will sit or lay in the arena),

- ○ Hazmat Signs,
- ○ QR codes,
- ○ Exit signs; green (according to the standard of the country the competition is held in; 2019 for example: https://www.australiansafetysigns.net.au/products/exit-landscape-exit-symbol-left-arrow)
- ○ Fire Extinguisher signs; red (according to the standard of the country the competition is held in; 2019 for example https://www.australiansafetysigns.net.au/products/fire-fire-extinguisher),
- ○ Heat source.
- ● (EXP 4) Avoid Holes: Drive and map while avoiding amorphous negative obstacles (holes) along a robot's path. This is for autonomous robots only.
- ● (EXP 5) Avoid Terrains: Drive and map while avoiding amorphous terrain obstacles without enclosing walls (e.g. stepfields, small obstacles). This is a test for autonomous robots only.

(Sample arena layout showing locations of all the test lanes set up for concurrent operation, limited only by the number of available test administrators and radio channels.)

Exploration and Mapping Tests can be conducted in a distributed fashion, in different but similarly instrumented environments, for preliminary qualification. Qualified teams then compete in the same environment at the in-person competition.
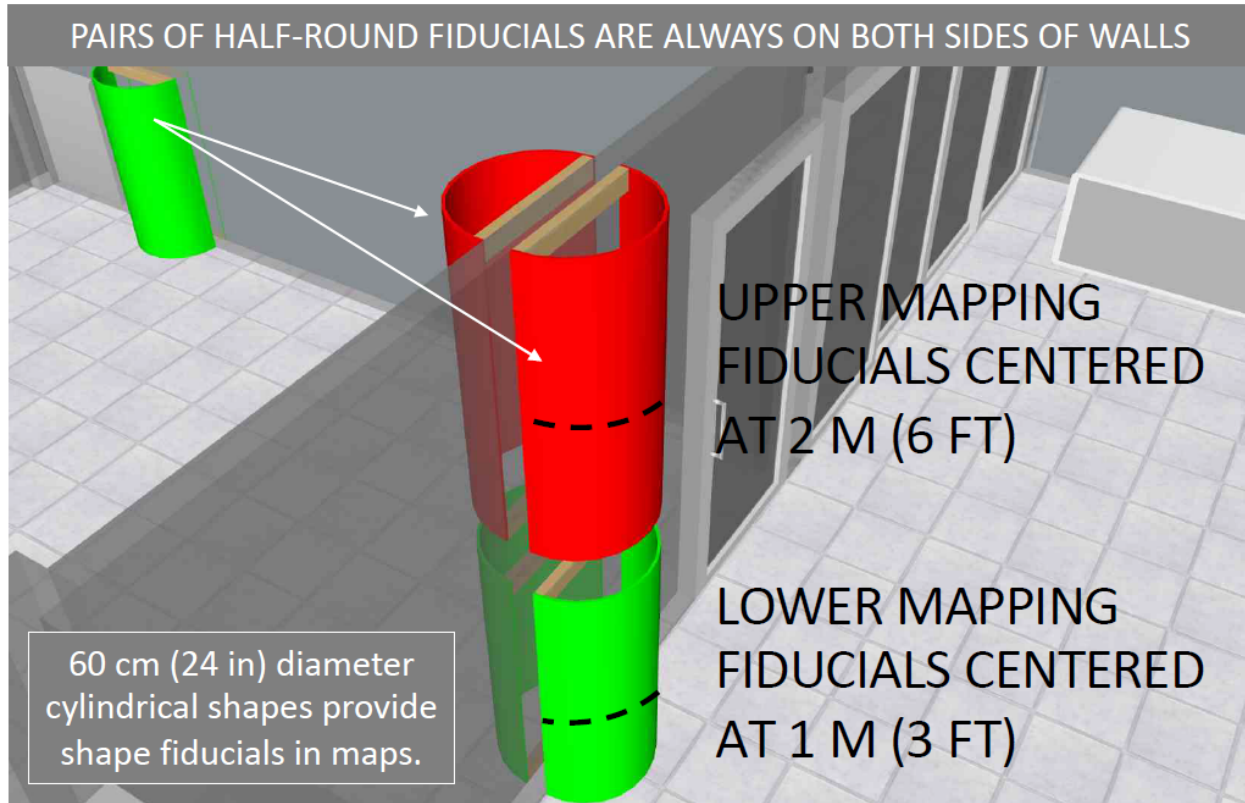

Distributed Exploration and Mapping Tests:

- ● Validate easy to replicate exploration and mapping tests in YOUR scenarios.
- ● Focus on reconfigurable task apparatuses that are easy to lay out temporarily and store between trials.
- ● Compare your 2D and 3D map results over time in variable/repeatable layouts within the same scenario.
- ● Try different scenarios using all the same layout rules, in houses, workplaces, industrial facilities, outdoor settings.

Fiducial Distribution:
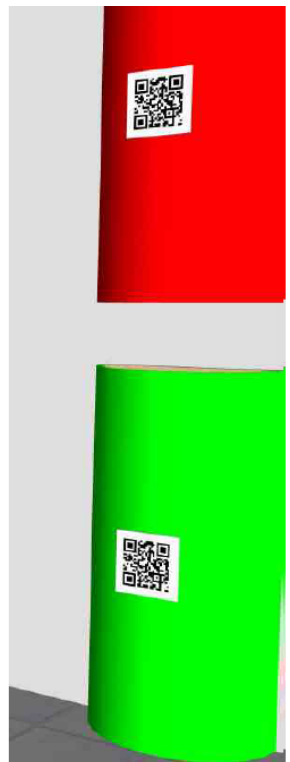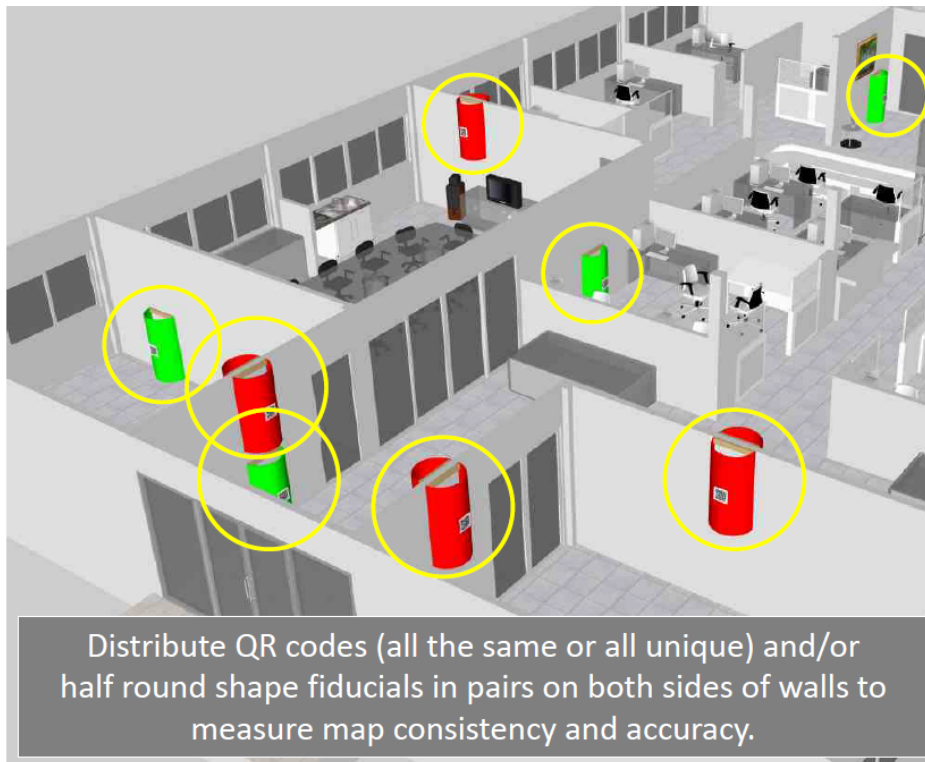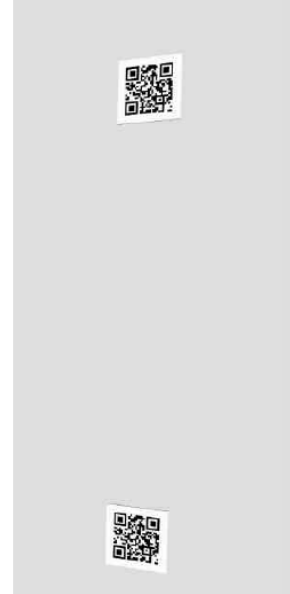
Distribute QR codes (all the same or all unique) and/or half round shape fiducials in pairs on both sides of walls to measure map consistency and accuracy.

PAIRS OF HALF-ROUND FIDUCIALS ARE ALWAYS ON BOTH SIDES OF WALLS

UPPER MAPPING FIDUCIALS CENTERED AT 2 M (6 FT)

LOWER MAPPING FIDUCIALS CENTERED AT 1 M (3 FT)

60 cm (24 in) diameter cylindrical shapes provide shape fiducials in maps.

(5) Upper fiducials
(5) Lower fiducials

Example Workplace Scenario

FIDUCIALS ALWAYS ON BOTH SIDES OF WALLS

UPPER MAPPING FIDUCIALS CENTERED AT 2 M (6 FT)
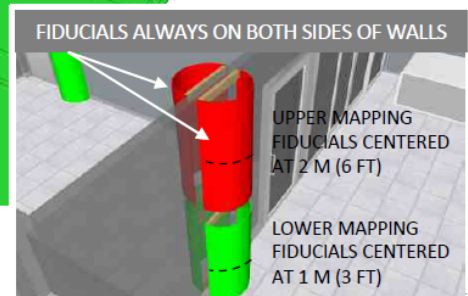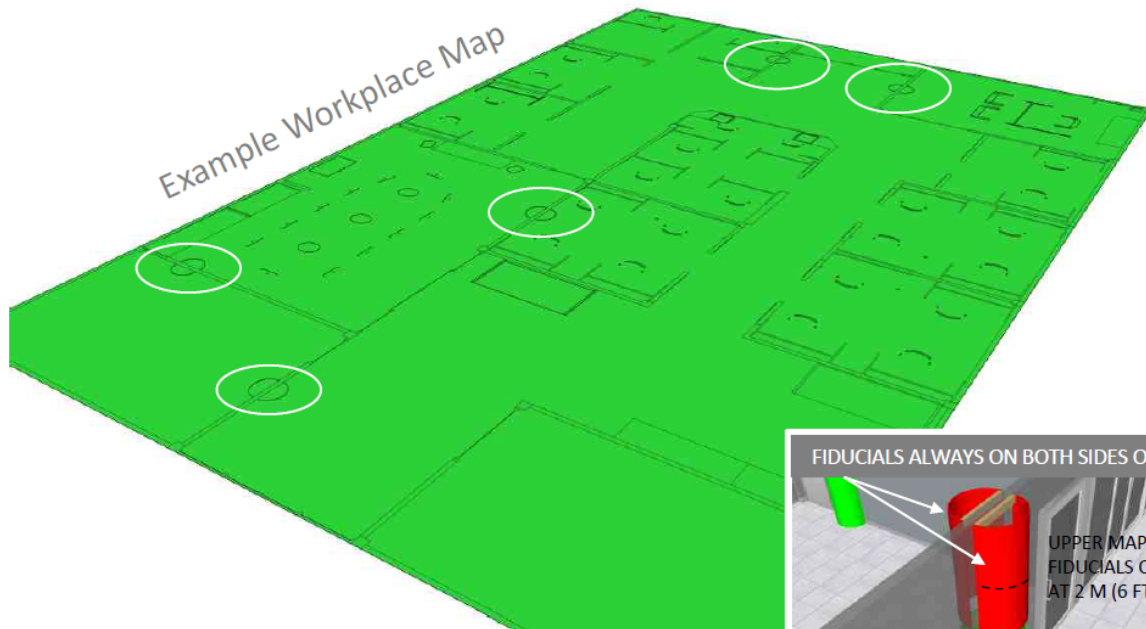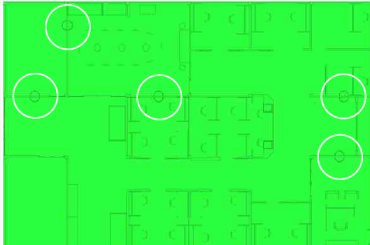
LOWER MAPPING FIDUCIALS CENTERED AT 1 M (3 FT)

Mapping:

Lower Fiducial Map
5 pairs of fiducials shown in a 3D map layer at 1 m (3 ft) elevation. The fiducial pairs should form circles in 2D maps.

Map Metrics:
- Coverage (how many of 10 are visible?)
- Consistency (how close are the pairs?)
- Local Accuracy (by room)
- Global accuracy (average overall)

(5) Upper fiducials
(5) Lower fiducials

Example Workplace Scenario

FIDUCIALS ALWAYS ON BOTH SIDES OF WALLS

UPPER MAPPING FIDUCIALS CENTERED AT 2 M (6 FT)

LOWER MAPPING FIDUCIALS CENTERED AT 1 M (3 FT)

Example Workplace Map

FIDUCIALS ALWAYS ON BOTH SIDES OF WALLS

UPPER MAPPING FIDUCIALS CENTERED AT 2 M (6 FT)

LOWER MAPPING FIDUCIALS CENTERED AT 1 M (3 FT)

Upper Fiducial Map
5 pairs of fiducials shown in a 3D map layer at 2 m (6 ft) elevation. The fiducial pairs should form circles in 2D maps.

(5) Upper fiducials
(5) Lower fiducials

Map Metrics:
- Coverage (how many of 10 are visible?)
- Consistency (how close are the pairs?)
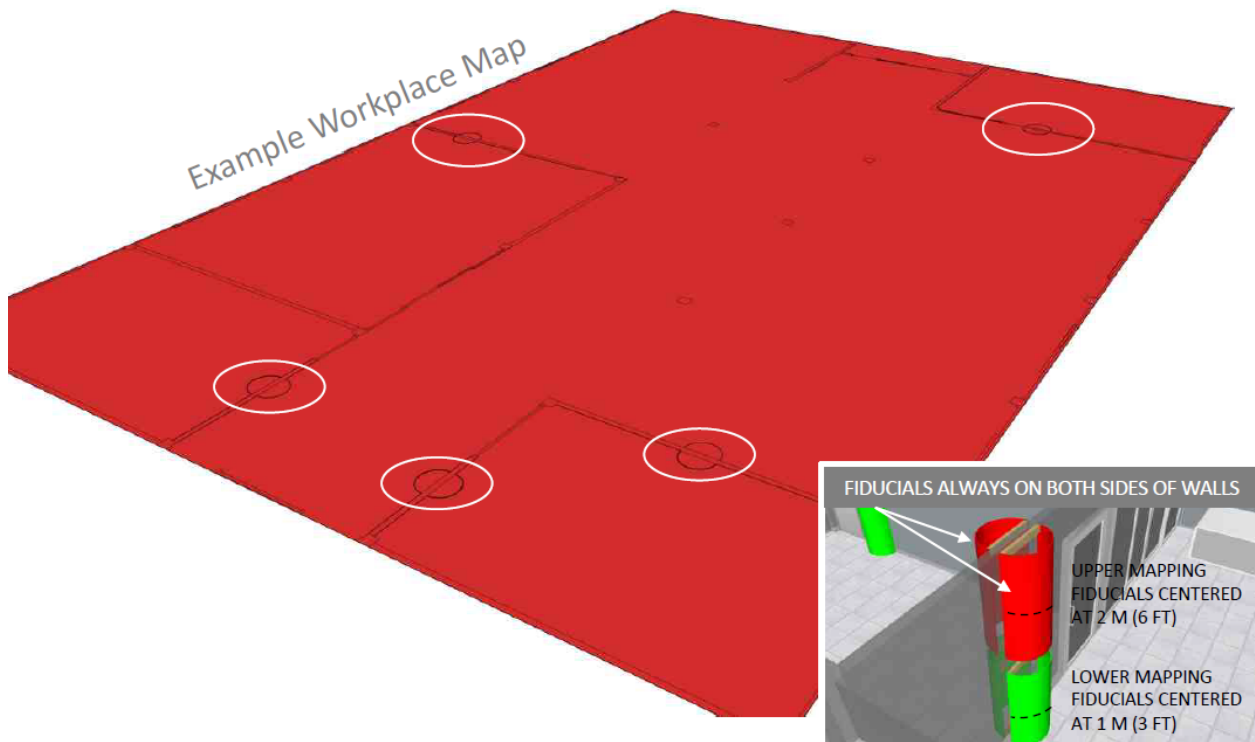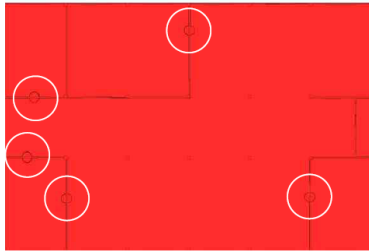- Local Accuracy (by room)
- Global accuracy (average overall)

Example Workplace Scenario

FIDUCIALS ALWAYS ON BOTH SIDES OF WALLS

UPPER MAPPING FIDUCIALS CENTERED AT 2 M (6 FT)

LOWER MAPPING FIDUCIALS CENTERED AT 1 M (3 FT)

Example Workplace Map

FIDUCIALS ALWAYS ON BOTH SIDES OF WALLS

UPPER MAPPING FIDUCIALS CENTERED AT 2 M (6 FT)

LOWER MAPPING FIDUCIALS CENTERED AT 1 M (3 FT)

See construction guide for details regarding construction of the fiducials.