



# MRC Indoor Navigation and Target Search Challenge

**Objective of the competition:** traverse autonomously through a cluttered environment in order to find targets described in the rules and move them to a specified location. Targets vary in complexity (of recognition and size) and in terms of awarded points. To earn points, the found targets have to be delivered to a specified location. Extra points also can be awarded for accomplishing the task with certain constraints. The team earning the highest points wins. In the event of a tie, time will be used as a deciding factor.

Participating members can be full-time graduate or undergraduates students registered before August 2018.

## Prizes and support

- Prizes: 1st place – \$1000, 2nd place – \$500.
- Mobile platform will be provided for all teams upon request. Mobile platform includes frame, motors, wheels, and motor drivers. Participating teams have to install all other required components as well as write code to control the robot.
- Teams can also request financial support for the necessary components which will be provided upon approval from the competition organizers.
- Provided mobile platform and the components have to be returned after the competition.
- Participating teams can use RRL facilities to assemble and test robots.
- There will be 1-2 meetings with each team during the semester to review the progress. Teams have to achieve certain milestones by that time to stay eligible for the financial support.

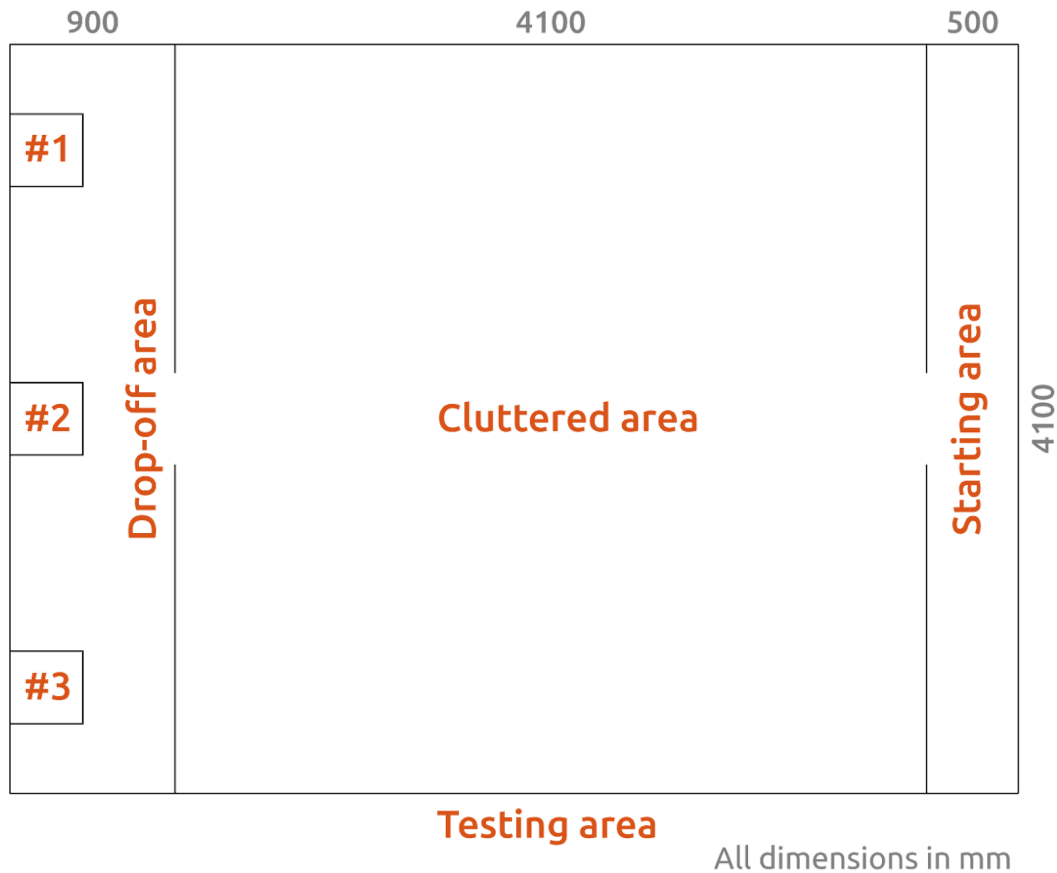
## Robot

- Only one robot can perform at a time. No flying drones or robotic groups/swarms can compete in the challenge.
- Dimensions of participating robots have to be within 300x300x600 mm. Maximum weight should not exceed 4 kg.

- Teams should attempt building and programming robots capable of completing the challenge tasks autonomously. However, teleoperation control is also allowed with several constraints:
  - 50% penalty will be imposed on the earned points;
  - teleoperator can only drive the robot but cannot be controlling the gripper/manipulator;
  - the robot cannot be driven closer than 10 cm to the target at which point the autonomous control has to be initiated for picking up and delivering the target.
- The robot has to be made by team members.
- Each robot has to have a safety shutdown switch.
- Wi-Fi (network hosted by organizers) is the preferred wireless communication method. Participants cannot set up their own Wi-Fi networks. Contact organizers if you choose to use something else.

## Testing area

- The testing area is a 5.5 x 4.1 m rectangular. Walls are made of cardboard. The clutter and obstacles vary in size and texture.
- All obstacles are fixed and immovable.
- The minimum distance between obstacles or walls in the testing area is 500 mm.
- Floor in the testing area is flat and even.



## Targets

- Targets award different number of points upon delivery. This value depends on
  - visual detection complexity;
  - shape/weight that makes it harder to pick up and carry;
- Generally targets are simple shape objects (cube, sphere, etc).
- All targets except the most valuable have similar handle for grippers (the geometry and dimensions will be announced later).
- Targets have various identifying patterns depending on the value (e.g. standard AR tags., black and white drawings, colored drawings).
- Targets have to be delivered to the correct drop-off area site (#1, #2, or #3) which will be specified in the target's description.
- Exact list of targets, their description and points value will be announced later.

## Points

- Teams have an option of receiving coordinates of the robot in the global frame of reference with 20% penalty points (80% will be awarded).

- Extra points will be awarded for building 2D map of the cluttered area with locations of the found targets. The map has to be accurate.
- Time of the run will be a deciding factor in case of equal points.

## Procedure

- Each robot starts the run in the starting area.
- During the run robots have to explore the cluttered area, find targets and deliver them to the drop-off area.
- Each run ends if any of the following happens:
  - robot malfunctions and cannot function properly;
  - the team calls to stop the run;
  - all of the targets were found and delivered;
  - 15 min elapsed.
- Teams have 2 attempts to do a run. The run with highest points will be used for scoring.
- Teams cannot interfere in any way with other teams' runs.
- All wireless communication with the robot has to cease during the autonomous run.
- During teleoperated run, the person controlling the robot has to be in the other room and use only the sensor data from the robot.
- If a robot breaks through the walls or leaves the testing area during the run, the run ends immediately with 0 points.
- Teams cannot set up any external devices (beacons, cameras, etc) to aid the run.

## General

- All code used for the robot control is encouraged to be made public.
- Teams are encouraged to use ROS as a framework for robot control.
- The organizers reserve the right to introduce any change in the rules and regulations of the MRC challenge.
- The organizers have the right to photograph and videotape the event.
- The decisions of the organizers/judges is final and subject to no-appeal.