The CDT Challenge

1 Introduction
This page describes the AIMS CDT Husky Time Trial competition setup and scoring. The goal is to **complete the challenge within the least amount of time, while not hitting obstacles.**

2 The Arena
The arena consists of a field with a random forest of obstacles, and a goal location marked by a high contrast circle on the ground:

The following objects exist in the environment:

- **Obstacles:** 10cm diameter PVC pipe coated with reflective tape, arranged randomly in the arena.
- **Target:** 1m diameter flat circle painted with high contrast paint. The target can be in any location past the 10-metre line and must be detected using onboard sensors.
- **Start position:** Low-visibility markers on the ground marking the start position of the Husky.
- **10-metre lines:** Low-visibility markers on the ground near the start position, and for marking 10 metres from the start position of the Husky.

At the start of the challenge, the Husky will be placed at the start position such that it is
pointing towards the target, which is at least 10 metres away.

3 The Task
The task consists of four phases: Exploration, Docking, Return and Parking. A stopwatch will be started at the beginning of the Exploration phase and will run continuously until completion of the Parking phase.

3.1 Exploration
The Exploration phase consists of the Husky traversing through the obstacles to cross the 10 metre line.

The goal of the Exploration phase is to position all four wheels of the Husky beyond the 10 metre line close to the target. The team will gain success points for crossing the 10 metre line. An incremental penalty will be applied for every collision with an obstacle. Collision with more than two obstacles will result in the team conceding the chance of gaining success points during this phase. The Husky must complete the Exploration phase in order to complete the challenge.
3.2 Docking

The Docking phase consists of the Husky driving on to the target as precisely as possible. The target position is not known precisely relative to the start position, and must be detected using the onboard cameras on the Husky.

To successfully dock, all four wheels of the Husky must be on the target. Success points will be attributed for any wheel on the target (at least partially) at the completion of the Docking phase.
3.3 Return

The Return phase consists of the Husky traversing back through the obstacles from the target position to the start position.

Similar to the Exploration phase, the goal of the Return phase is to position all four wheels of the Husky beyond the 10 metre line close to the start position. The team will gain success points for crossing the 10 metre line, and an incremental penalty will be applied for every collision with an obstacle. As in the Exploration phase, colliding with more than two obstacles will result in the team forfeiting the chance of gaining success points during this phase. The return phase is complete when the Husky is in the vicinity of the start position.
3.4 Parking

The Parking phase consists of the Husky returning to the start position as precisely as possible.

To successfully park, each wheel of the Husky must be aligned as closely as possible to the start position markers. Success points will be attributed for any wheel on the start position (at least partially) at the completion of the Parking phase.
4 System Implementation

The diagram below shows the system structure and the blocks needed to complete the challenge. Some of those will be provided to you, such as the one implementing SLAM; the teams will need to take care of the other blocks. Additional details will provided later in the week.

5 Additional Rules

5.1 Manual Intervention
At any point during the time trial, the robot operators may intervene with the autonomous operation of the robot by releasing the deadman switch and manually driving the Husky. However, this may only be used for limited manoeuvres (to avoid danger, obstacles or to reposition the robot).
6 Scoring

The score is the total amount of success points accumulated minus any penalties. Penalties account for the time taken to complete the challenge, and for any obstacles hit while doing it. More specifically, the final score will be computed as:

\[
\text{Finale Score} = \text{Success Points} - \text{Obstacle Penalties} - \text{Time Taken (in seconds)}
\]

The team with the highest score will win the challenge. The following table lists the different success points and penalties.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Success Points / Penalties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration: Crossing the 10-metre line close to the target</td>
<td>+100 points</td>
</tr>
<tr>
<td>Docking: Positioning wheels on the target</td>
<td>+400 points (100 points for each wheel on the target, at least partially)</td>
</tr>
<tr>
<td>Return: Crossing the line close to the starting position</td>
<td>+200 points</td>
</tr>
<tr>
<td>Parking: Positioning wheels on the starting position</td>
<td>+800 points (+200 points for each wheel on the start position, at least partially)</td>
</tr>
<tr>
<td>Collision with one obstacle</td>
<td>-50 points</td>
</tr>
<tr>
<td>Collision with a second obstacle</td>
<td>-100 points</td>
</tr>
<tr>
<td>Collision with a third obstacle</td>
<td>no chance to gain any success point for the phase</td>
</tr>
</tbody>
</table>

7 Prizes

The winning team will get the Best-MRG-Robot-Team-Ever-This-Year™ trophy, printed on a 3D printer.