

# RCAP CoSpace Autonomous Driving Challenge Rules

These are the official rules for RCAP CoSpace Autonomous Driving Online Challenge 2024. This rule book is released by the RoboCup Asia-Pacific CoSpace Technical Committee. English rules have priority over any translations. Changes from the 2021 rules are highlighted in red.

## PREFACE

The RCAP CoSpace Autonomous Driving Challenge focuses on path planning in a smart city. For this challenge, teams are required to program autonomous vehicles to navigate through a smart city in virtual environments (CoSpace).

The CoSpace Autonomous Driving Simulator is the only official platform for the CoSpace Autonomous Driving Challenge. This simulator allows programs to be developed using a graphical programming interface (GUI), Python or C language. The same program for the virtual robot in the virtual environment can be downloaded on to a real robot in the real environment. Participating teams can contact [nilesh.isclrobotics@gmail.com](mailto:nilesh.isclrobotics@gmail.com) for CoSpace Auto-Driving Simulator download, help and assistance.

In the CoSpace Autonomous Driving FirstSteps, U12 category, students will only compete in **VIRTUAL\_WORLD**.



Figure 1: CoSpace Auto-driving Challenge



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## CHAPTER 1: GENERAL RULES

### 1 CoSpace Autonomous Driving Challenge (Onsite) Description

The RCAP CoSpace Autonomous Driving Challenge focuses on path planning in a smart city. For this challenge, teams are tasked to code the virtual robot and finally, take part in the autonomous driving challenge in VIRTUAL\_WORLD.

**Duration of the challenge: 4 minutes**

### 2 Team

#### 2.1. Team Members

2.1.1 **A CoSpace Auto-driving team should consist of 2 to 4 members.** Each participant can only register for one team.

2.1.2 Each team must have a captain. The captain is responsible for communication with referees during the game.

2.1.3 Teams with all students aged 7 to 12 year old can take part in CoSpace Auto-driving Challenge FirstSteps, U12 category. Age is as specified on 1st July in the year of the competition.

#### 2.2 Responsibility

2.2.1 The team members are responsible for

- verifying the latest version of the rules prior to the competition. If any rule clarification is needed, please contact the CoSpace Technical Committee.
- checking updated information (schedules, meetings, announcements, etc.) during the event.
- Coding VIRTUAL\_ROBOT in VIRTUAL\_WORLD.
- uploading the correct code to VIRTUAL\_ROBOT.
- communication with CoSpace Technical Committee and Organising Committee for all CoSpace Auto-Driving Challenge related matters.

### 3 Referees

#### 3.1. Official

3.1.1 A referee is an official who manages the CoSpace Auto-driving Challenge and makes sure that the CoSpace Auto-driving rules are followed.

3.1.2 The referee receives and uploads the teams' virtual programs, as well as running the game.

### 4 Human Interference

4.1.1 Human interference during the game is not allowed.

4.1.2 In any case, only the team captain is allowed to communicate with the referee.

## 5 Interruption of a Game

- 5.1.1 In principle, a game will not be stopped during the challenge unless the referee needs to discuss an issue/problem with the OC/TC.

## 6 Conflict Resolution

### 6.1. Referee

- 6.1.1 During the CoSpace Auto-driving challenge, the referee's decisions are final.
- 6.1.2 At the conclusion of a game, the referee will ask the captain to sign the CoSpace Auto-driving result sheet. Captains are given a maximum of 1 minute to review the result and sign. By signing it, the captain accepts the result on behalf of the entire team. In case of further clarification, the team captain should write their comments on the result sheet and sign it.
- 6.1.3 A violation of the rules may result in disqualification from the tournament or the round at the discretion of the referee, officials, organizing committee and general chairs.
- 6.1.4 In case the team refuses to sign the scoresheet after the game, they should be advised to file a complaint following the procedure in section 6.4. This should not interrupt the following games. The referee should follow the instruction given by the chief judge.

### 6.2. Rule Clarification

- 6.2.1 It is the team's responsibility to verify on the official website the latest version of the rules prior to the competition. If any rule clarification is needed, please contact the CoSpace Technical Committee.
- 6.2.2 If necessary, a rule clarification may be made by members of the CoSpace Technical Committee and Organizing Committee, even during a tournament.

### 6.3. Special Circumstances

- 6.3.1 Under special circumstances, such as the occurrence of unforeseen problems or malfunctions of the robot, rules may be modified by the Organizing Committee Chair in conjunction with available Technical Committee and Organizing Committee members, if necessary, even during a tournament.
- 6.3.2 If any of the team captains/members/mentors do not show up to the team meetings to discuss the problems and the resulting rule modifications described in 6.3.1, it will be considered as an endorsement.

### 6.4. Complaint Procedure

- 6.4.1 Rule issues are not to be discussed during the run. Referee decisions are binding for the CoSpace Auto-driving challenge.

To initiate the complaint procedure, the team leader of the challenging team has to contact a member of the Technical Committee within 10 minutes of the end of the run. The member of

- 6.4.2 the Technical Committee will then invoke a team leader conference in consultation with the

Organizing Committee. The following parties will participate in this conference: the referees of the run, Organising Committee members, and the Technical Committee (counselling). The situation shall be resolved by unanimous consent or by vote of the Organising Committee members. The chief charge should inform the referee concern about the final decisions.

- 6.4.3 All teams are reminded that while this is a competition, the league is also about cooperative research and evaluation, as such, complaints should be handled in a fair and forthcoming way.

## 7 Documentation

### 7.1 My First RoboCup Journey

- 7.1.1 Teams are required to submit the document – My first robocup journey prior to the event. ([https://2023.robocupap.org//download/RCAP2023\\_My\\_First\\_Robocup\\_Journey\\_Template.pdf](https://2023.robocupap.org//download/RCAP2023_My_First_Robocup_Journey_Template.pdf))

### 7.2 Team Presentation Video

- 7.2.1 Each team is required to submit a team presentation video 3 weeks before the competition. The highlighted videos will be showcased in RCAP Academy YouTube Official Channel ([youtube.com/rcapacademy](https://youtube.com/rcapacademy)). Template and guidelines will be given by the Technical Committee.

## 8 Code of Conduct

### 8.1 Fair Play

- 8.1.1 CoSpace Auto-driving Challenge is built upon the foundation of fairness, respect, and friendship. Team members should be mindful of other people and their robots when moving around the tournament venue.
- 8.1.2 Mentors (teachers, parents, chaperones, translators, and other adult team members) are not allowed in the student work area. They are not allowed to be involved in the programming of students' robots.

### 8.2 Behaviour

- 8.2.1 Prior to the Challenge, team leaders and mentors are required to sign and acknowledge that they fully understand and are aware of the rules as well as Code of Conducts for the Challenge. All participants are responsible for their own actions.
- 8.2.2 During challenge, participants are to follow the directions of the referee. Failure to do so will result in a WARNING (Yellow Card). Subsequent infractions will result in an automatic DISQUALIFICATION (Red Card) of the round. Disqualification as a result of deliberately distract the competition is FINAL and appeals will not be entertained in any form. The status of Yellow/Red Cards will be recorded.
- 8.2.3 WARNING (Yellow Card) procedure
- A WARNING can be issued at the sole discretion of the lead referee; however, assistant referee will be consulted. If no objection is raised, WARNING will be issued.
  - A WARNING will be issued for the following disruptive behaviours and activities including but not limited to:

- (a) Not following referee's instructions
- (b) Disturbing other participants and/or competition staffs (including referees).
- (c) Speaking loudly, shouting, using any kind of profanities or making sound that resembles profanity.
- (d) Sabotaging other teams belongings or equipment
- (e) Entering competition area when other teams are competing.
- (f) Entering other teams' area without explicit permission.
- (g) Engaging in disorderly conducts such as fighting, physical scuffles, running around competition and/or team area.
- (h) Harassing referee
- (i) Mentor interference with robots or referee decisions.

#### 8.2.4 DISQUALIFICATION (Red Card) procedure

- A DISQUALIFICATION can be issued at the sole discretion of the lead referee; however, assistant referee will be consulted. If no objection is raised, DISQUALIFICATION will be issued.
- An immediate DISQUALIFICATION can only be issued jointly by the lead and assistant referee. A DISQUALIFICATION will be issued for the following cases:
  - (a) Teams have collected two consecutive WARNINGS during competition period. A competition period is defined as the start to end of duration of competition.
  - (b) If one team copies a program from another team, both teams will be disqualified.

8.2.5 Once a RED CARD is issued, the team will be disqualified from the current run. If team receives 2 RED CARDS, it will be disqualified from the whole entire competition.

8.2.6 All immediate DISQUALIFICATION will be reviewed by the Chief Judge and the Organising Committee. Infractions that resulted in immediate DISQUALIFICATION will be reviewed and additional sanctions such as bans from future competitions will be considered.

### 8.3 Penalty

8.3.1 The following are strictly prohibited.

- (a) During the game, using third-party software, self-written code, or any other tools to retrieve additional system information is strictly prohibited.
- (b) Any other behaviours that affect the normal operation of the RCAP CoSpace Auto-Driving Simulator, and direct or indirect control of the behaviours of the RCAP CoSpace Auto-Driving Simulator, such as the scaling of the simulation window is strictly prohibited.

8.3.2 A DISQUALIFICATION from the current match can be issued at the sole discretion of the CoSpace Chief Judge and CoSpace Technical Committee if teams offend the rules 8.3.1 for the first time.

8.3.3 A DISQUALIFICATION from the entire competition can be issued at the sole discretion of the CoSpace Chief Judge and CoSpace Technical Committee for repeat offenders.

### 8.4 Sharing

- 8.4.1 Teams are encouraged to share their codes and strategies with members after the competition.
- 8.4.2 Any developments may be published on the RCAP Academy Channel or CoSpaceRobot.org after the event.
- 8.4.3 RCAP CoSpace Autonomous Driving sharing furthers the mission of RoboCup Asia-Pacific (RCAP) as an educational initiative.

## 8.5 Spirit

- 8.5.1 It is expected that all participants (students and mentors alike) will respect the RoboCup Asia-Pacific (RACP) mission.
- 8.5.2 The referees and officials will act within the spirit of the event.
- 8.5.3 It is not whether you win or lose, but how much you learn that counts!

## CHAPTER 2: FIELDS

### 9 VIRTUAL\_WORLD

#### 9.1 VIRTUAL\_WORLD Layout

9.1.1 The VIRTUAL\_WORLD may consist any of black/white guidelines, obstacles, gantries, waypoints, detour markers, or mysterious tasks. **The surface colour will not distract the robot's detection or movement.**

##### 9.1.2 Black/White Guidelines

- There will be black line on light road or white guideline on dark road.
- The black/white guideline forms a path to guide the virtual robot.
- Straight sections of the black/white guideline may have gaps with at least 5 cm of straight line before each gap. The length of a gap will be no more than 20 cm.



Figure 2: Black / white guideline

##### 9.1.3 Obstacles

The virtual obstacles can be walls, buildings, cylinders, or cubes. The size, design and colour of obstacles can be varied.

##### 9.1.4 Gantries

Gantry is an overhead assembly on which certain signs or signals are posted. Gantry will not block the road. The design and colour of gantries can be varied.



Figure 3: Example of a gantry



### 9.1.5 Waypoints

The virtual robot needs to pass all waypoints in the virtual environment. The size of waypoint is not fixed. It is orange in colour.



Figure 4: Waypoint

### 9.1.6 Termination Markers

This is the terminal point of the Black/White guideline.



Figure 5: Termination marker

### 9.1.7 Finish Lines

The mission is completed when VIRTUAL\_ROBOT passes the finish line. The finish line will be indicated by the following symbols.

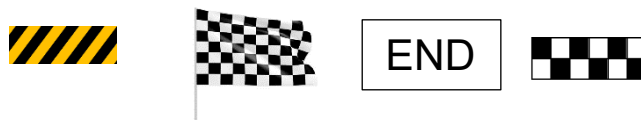


Figure 6: Finish Line

Typical VIRTUAL\_WORLD layout:



Figure 7: VIRTUAL\_WORLD Layout



## CHAPTER 3: ROBOT

### 10 VIRTUAL\_ROBOT

#### 10.1 VIRTUAL\_ROBOT Configuration

10.1.1 The VIRTUAL\_ROBOT configuration is as follows:

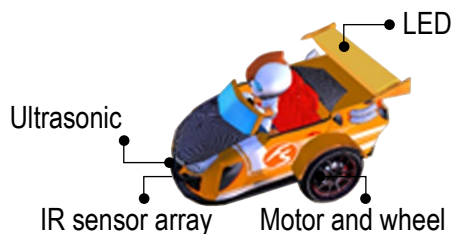


Figure 8: Virtual robot

#### 10.2 Coding for VIRTUAL\_ROBOT

10.2.1 Teams can use CoSpace GUI, Python or C to program the VIRTUAL\_ROBOT to complete the task in VIRTUAL\_WORLD.

## CHAPTER 4: GAMEPLAY, JUDGING AND AWARD

### 11 Gameplay

#### 11.1 Release of Task

11.1.1 The Organising Committee will announce the tasks in the competition hall.

#### 11.2 Submission of 1st AI

11.2.1 The chief judge will announce the time for AI submission of the first AI in the competition hall.

11.2.2 Each team must submit their first AI strategy which is created during the programming period (we'll call it AI\_1) to the chief judge.

#### 11.3 Start of Each Round of Game

11.3.1 5 minutes before each run, team captains must report to the referee at their respective game stations.

11.3.2 The 1st run will use the AI\_1 submitted at the end of the coding session. No re-submission of AI\_1 is allowed.

11.3.3 Starting from the 2nd run onwards, teams are allowed to submit a revised version of their AI to the referee if they wish to make a change to the previous AI. This has to be done 5 minutes before each run.

11.3.4 The referee will continue to use the AI\_1 or the previous version of AI if there is no submission of revised AI received 5 minutes before the run. The referee must confirm the correct AI to use with the team captain.

11.3.5 No modification of AI is allowed once the run begins.

#### 11.4 Virtual Run

11.4.1 The referee will upload the programs onto the CoSpace server and place the VIRTUAL\_ROBOT in the initial station in the VIRTUAL\_WORLD.

11.4.2 It is the team captain's responsibility to ensure that the correct program is uploaded.

11.4.3 Team captains must be present during the virtual run.

11.4.4 VIRTUAL\_ROBOT is required to pass all waypoints or gantries successfully in any order. VIRTUAL\_ROBOT does not need to stop at the waypoints.

11.4.5 The VIRTUAL\_ROBOT should avoid all obstacles.

11.4.6 When VIRTUAL\_ROBOT reaches the "Finish" line, the game ends.

## CHAPTER 5: JUDGING AND AWARD

### 12.1 Ranking

The teams are ranked as follows:

	<b>Situation</b>	<b>Rank</b>
Tier 1	<ul style="list-style-type: none"><li>VIRTUAL_ROBOT passes all waypoints and reaches the finish line.</li></ul>	<ul style="list-style-type: none"><li>The team rank is determined by the game time at the finish line in the VIRTUAL_WORLD.</li></ul>
Tier 2	<ul style="list-style-type: none"><li>VIRTUAL_ROBOT is not able to pass all waypoints (regardless whether it reaches the finish line or not)</li></ul>	<ul style="list-style-type: none"><li>The race time for VIRTUAL_ROBOT to reach the last waypoint will be recorded.</li><li>The team rank will be determined based on the number of waypoints passed followed by the game time.</li></ul>

### 12.2 Awards

Depending on the number of teams entering the competition, there will be awards (trophies and certificates). The Organizing Committee can adjust the award type (trophy or certificate) if needed.

RCAP CoSpace Technical Committee

### Contact us:

Rule clarification: [nilesh.lscrobotics@gmail.com](mailto:nilesh.lscrobotics@gmail.com)

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