



AIUB
PRESENTS

**NOTRE DAME
ANNUAL SCIENCE
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AND 29TH GKC**

THE RULEBOOK

Preface

In the Robo Soccer challenge, teams of young enthusiasts design, build, and program two fully autonomous or remote controlled mobile robots to compete against another team in matches. The robots must direct a ball and score into a color-coded goal on a special field that resembles a human soccer field.

To be successful, participants must demonstrate skill in programming, robotics, electronics and mechatronics. Teams are also expected to contribute to the advancement of the community as a whole by sharing their discoveries with other participants and by engaging in good sportsmanship, regardless of culture, age or result in the competition. **All are expected to compete, learn, have fun, and grow.**

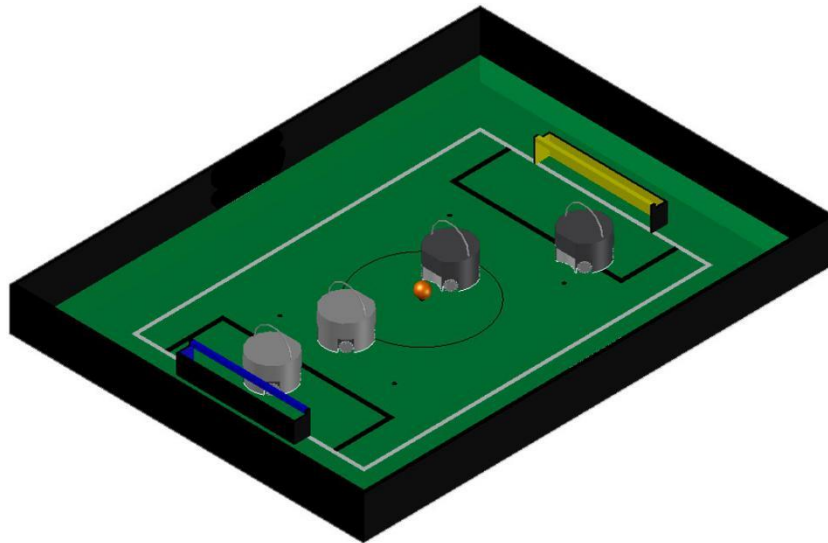


Figure 1: Two teams of two robots with a ball on a Robo Soccer.

Construction and Programming are expected to be performed exclusively by the students

Robots must be constructed and programmed exclusively by student members of the team. Mentors, teachers, parents or companies should not be directly involved in the design, construction, assembly, programming or debugging of robot. For any query please refer to the host..

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1 GAMEPLAY

1.1 Game procedure and length of a game

- 1.1.1 Robo Soccer game consist of two teams of robots playing soccer against each other. Each team has two robots. The game will consist of two halves. The duration of each half is 10-minutes. There will be a 5-minute break in between the halves.

- 1.1.2 The game clock will run for the duration of the halves without stopping (except if or when a referee wants to consult another official). The game clock will be run by a referee or a referee assistant (see Rule 7.1 for the description of a referee assistant).
- 1.1.3 Teams are expected to be on the field 5 minutes before their game starts. Being at the inspection table does not count in favor of this time limit. Teams that are late for the start of the game can be penalized one goal per 30 seconds at the referee's discretion. In this (and any) situation, when the goal differential reaches 10 the game finishes regardless of the state of the game clock.

1.2 Pre-match meeting

- 1.2.1 At the start of the first half of the game, a referee will toss a coin. The team mentioned first in the draw shall call the coin. The winner of the toss can choose either which end to kick towards, or to kick off first. The loser of the toss chooses the other option. After the first half, teams switch sides. The team not kicking off in the first half of the game will kick off to begin the second half of the game.
- 1.2.2 During the pre-match meeting the referee or their assistant may check whether the robots are capable of playing (i.e., whether they are at least able to follow and react to the ball). If none of the robots is capable of playing, the game will not be played and zero goals will be awarded to both teams.

1.3 Kick-off

- 1.3.1 Each half of the game begins with a kick-off. All robots must be located on their own side of the field. All robots must be halted. The ball is positioned by a referee in the center of the field.
- 1.3.2 The team kicking off places their robots on the field first. Robots cannot be placed nor remain behind the goal line or in the outer area. Robots cannot be repositioned once they have been placed.
- 1.3.3 The team not kicking off will now place their robots on the defensive end of the field. All robots on the team not kicking off must be at least 30 cm away from the ball (outside of the center circle).
- 1.3.4 Robots cannot be placed behind the goal line or out of bounds. Robots cannot be repositioned once they have been placed, except if the referee requests to adjust their placement to make sure that the robots are placed properly within the field positions.
- 1.3.5 On the referee's command (usually by whistle), all robots will be started immediately by each captain. Any robots that are started early will be removed by the referee from the field and treated as a damaged robot.

1.4 Human interference

- 1.4.1 Except for the kick-off, human interference from the teams (e.g. touching the robots) during the game is not allowed unless explicitly permitted by a referee. Violating team/team member(s) can be disqualified from the game.
- 1.4.2 The referee or a referee assistant can help robots get unstuck if the ball is not being disputed near them and if the situation was created from normal interaction between robots (i.e. it was not a design or programming flaw of the robot alone). The referee or a referee assistant will pull back the robots just enough for them to be able to move freely again.

1.5 Ball movement

- 1.5.1 A robot cannot hold a ball. Holding a ball is defined as taking full control of the ball by removing all of degrees of freedom. Examples for ball holding include fixing a ball to the robot's body, surrounding a ball using the robot's body to prevent access by others, encircling the ball or somehow trapping the ball with any part of the robot's body. If a ball does not roll while a robot is moving, it is a good indication that the ball is trapped.
- 1.5.2 The only exception to holding is the use of a rotating drum (a "dribbler") that imparts dynamic back spin on the ball to keep the ball on its surface.
- 1.5.3 Other players must be able to access the ball.

1.6 Scoring

- 1.6.1 A goal is scored when the ball strikes or touches the back wall of the goal. Goals scored either by an attacking or defending robot have the same end result: they give one goal to the team on the opposite side. After a goal, the game will be restarted with a kick-off from the team who was scored against. Before a kick-off, all damaged or out-of-bounds robots are allowed to return to the playing field immediately if they are ready and fully functional.

1.7 Goalie

- 1.7.1 The robot moving first into the penalty area on a team's defending side completely (with every part of it) is designated as goalie until a part of it leaves the penalty area.

1.8 Pushing

- 1.8.1 Within the penalty area, the goalie has priority. Attacking robots are not supposed to push the goalie in any way.
- 1.8.2 If the attacker and the goalie touch each other and at least one of them has physical contact with the ball, the ball will be moved to the nearest unoccupied neutral spot immediately.
- 1.8.3 If a goal is scored as a result of this pushed-situation, it will not be granted.

1.9 Lack of progress

- 1.9.1 Lack of progress occurs if there is no progress in the gameplay for a reasonable period of time and the situation is not likely to change. Typical lack of progress situations are when the ball is stuck

between robots, when there is no change in ball and robot's positions, or when the ball is beyond detection or reach capability of all robots on the field.

1.9.2 After a visible and loud count¹, a referee will call "lack of progress" and will move the ball to the nearest unoccupied neutral spot. If this does not solve the lack of progress, the referee can move the ball to a different neutral spot.

1.10 Out of bounds

1.10.1 If a robot's entire body moves out beyond the white line of the field, it will be called for being out of bounds. When this situation arises, the robot is given a one-minute penalty, and the team is asked to remove the robot from the field. There is no time stoppage for the game itself. The robot is allowed to return if a kickoff occurs before the penalty has elapsed.

1.10.2 The one-minute penalty starts when the robot is removed from play. Furthermore, any goal scored by the penalized team while the penalized robot is on the field will not be granted. Out-of-bounds robots can be fixed if the team needs to do so, as described in 1.11.

1.10.3 After the penalty time has passed, robot will be placed on the unoccupied neutral spot **furthest from the ball, facing its own goal.**³

1.10.4 A referee can waive the penalty if the robot was accidentally pushed out of bounds by any other robot. In such a case, the referee may have to slightly push the robot back onto the field.

1.10.5 The ball can leave and bounce back into the playing field. The referee calls "out of reach", and will move the ball to the nearest unoccupied neutral spot when one of the following condition occurs:

1. the ball remains outside the playing field too long, after a visible and loud count, (usually a count of **three** ⁴, the length of the count can be decided by the OC before a competition as long as it is the same length within a sub-league)
2. any of the robots are unable to return it into the playing field (without their whole body leaving the playing field), or
3. the referee determines that the ball will not come back into the playing field.

1.11 Damaged robots

1.11.1 If a robot is damaged, it has to be taken off the field and must be fixed before it can play again. Even if repaired, the robot must remain off the field for at least one minute or until the next kickoff is due. If all robots have moved out of bounds, the penalties are discarded and the match resumes with a neutral kickoff.

Some examples of a damaged robot include:

- it does not respond to the ball, or is unable to move (it lost pieces, power, etc.).
- it continually moves into the goal or out of the playing field.
- it turns over on its own accord.

¹usually a count of **three** ², the length of the count could be decided by the OC before a competition as long as it's the same length within a sub-league

³In previous version of the rules this was "nearest to where it has been taken off, orientated towards the nearest wall. Alternatively, the referee may instruct the team to place the robot on the neutral spot on the side of the field currently farthest from the ball, oriented towards the closest wall."

⁴In previous version of the rules this was "five"

- 1.112 Computers and repair equipment are not permitted in the playing area during gameplay. Usually, a team member will need to take the damaged robot to an “approved repair table” near the playing area. A referee may permit robot sensor calibration, computers and other tools in the playing area, only for the 5 minutes before the start of each half. Reprogramming of robots during the gameplay can only happen when they are out of game (i.e., damaged or out of bounds), or when explicitly allowed by the referee.
- 1.113 After a robot has been fixed, it will be placed on the unoccupied neutral spot **furthest from the ball, facing its own goal.**⁵ A robot can only be returned to the field if the damage has been repaired. If the referee notices that the robot was returned to the field with the same original problem, s/he may ask the robot to be removed, and proceed with the game as if the robot had not been returned.
- 1.114 **Only the referee decides whether a robot is damaged.** A robot can only be taken off or returned with the referee’s permission.
- 1.115 If both robots from the same team are deemed damaged at kickoff, gameplay will be paused and the remaining team will be awarded 1 goal for each elapsed 30 seconds that their opponent’s robots remain damaged. However, these rules only apply when none of the two robots from the same team were damaged as the result of the opponent team violating the rules.
- 1.116 **Whenever a robot is removed from play, its motors must be turned off.**

1.12 Multiple defense

- 1.121 Multiple defense occurs if more than one robot from the defending team enters its penalty area with some part and substantially affects the game. The robot farther from the ball will be moved to the nearest neutral spot. Only the referee can take this action at any time when both robots linger in their penalty area.
- 1.122 If multiple defense happens repeatedly in a short amount of time, the offending robot will be moved to an unoccupied neutral spot on the other side of the field, orientated towards the nearest wall. If any robot needs to be moved to an unoccupied neutral spot more than **three times** during its single uninterrupted time chunk on the field, it will be deemed damaged⁶.

1.13 Interruption of Game

- 1.131 In principle, a game will not be stopped.
- 1.132 A referee can stop the game if there is a situation on or around the field which the referee wants to discuss with an official of the tournament or if the ball malfunctions and a replacement is not readily available.
- 1.133 When the referee has stopped the game, all robots must be stopped and remain on the field untouched. The referee may decide whether the game will be continued/resumed from the situation in which the game was stopped or by a kick-off.

⁵~~In previous version of the rules this was “nearest to where it has been taken off, orientated towards the nearest wall. Alternatively, the referee may instruct the team to place the robot on the neutral spot on the side of the field currently furthest from the ball, orientated towards the nearest wall.”~~

⁶For the purpose of this rule a time chunk is defined as time between two events when the robot is taken off the field for some reason (e.g. at the end of the first half of the game, when it is deemed damaged or out of bounds).

2 TEAM

2.1 Regulations

- 2.1.1 A team must have more than one member to form a Robo Soccer team to participate in the event. A team member(s) and/or robot(s) cannot be shared between teams.
- 2.1.2 Each team member needs to carry a technical role.
- 2.1.3 Each team must have a **captain**. The captain is the person responsible for communication with referees. The team can replace its captain during the competition. Team is allowed to have at most two members beside the field during game play: they will usually be the captain and an assistant team member.

2.2 Violations

- 2.2.1 Teams that do not abide by the rules are not allowed to participate.
- 2.2.2 The referee can interrupt a game in progress if any kind of interference from spectators is suspected (color clothing, IR emitters, camera flashes, mobile phones, radios, computers, etc.).

3 ROBOTS

3.1 Number of robots / substitution

- 3.1.1 Each team is allowed to have at most two robots for the full tournament. The substitution of robots during the competition within the team or with other teams is forbidden.

3.2 Interference

- 3.2.1 Robots are not allowed to be colored orange, yellow, blue, or any other color that can be confused with a landmark (see 4.3) in order to avoid interference. Orange, yellow, blue⁸ colored parts used in the construction of the robot must either be occluded by other parts from the perception by other robots or be taped/painted with a neutral color.
- 3.2.2 The robot must not emit infrared light. However, optical sensors (e.g. infrared-distance-sensors) may be used as long as they do not affect other robots.
- 3.2.3 Infrared light reflecting materials must not be used on the outside. If robots are painted, they must be painted matte. Minor parts that reflect infrared light could be used as long as other robots are not affected. Robots must not produce magnetic interference in other robots on the field.
- 3.2.4 Robots must not produce visible light that may prevent the opposing team from playing when placed on a flat surface. Any part of a robot that produces light that may interfere with the opposing robot's vision system must be covered.
- 3.2.5 A team claiming that their robot is affected by the other team's robot in any way must show the proof/evidence of the interference. Any interference needs to be confirmed by an OC member if a claim is placed by the other team.

3.3Control

- 3.3.1 The use of remote control of any kind is not allowed during the match. Robots must be started and stopped manually by humans and be controlled autonomously.

3.4Communication

- 3.4.1 Robots are allowed to use communication during game play. Teams are responsible for their communication. The availability of frequencies cannot be guaranteed.

3.5Agility

- 3.5.1 Robots must be constructed and programmed in a way that their movement is not limited to only one dimension (defined as a single axis, such as). They must move in all directions, for example by turning. Robots must respond to the ball in a direct forward movement. For example, it is not enough to basically just move left and right in front of their own goal, it must also move directly

⁸In previous version of the rules this was "*or any landmark-like*"

⁹range shorter than 20 meters

4 Field

