

## **RC Humanoid Soccer league rules**

### **Preface**

In the RoboCupJunior Humanoid soccer league, a team of two autonomous humanoid robots competes against another team in matches. They must look for a ball, trying to score into a color-coded goal in a special field built in a way that resembles the actual field for human soccer. Robots are required to have full autonomy from humans and technical design, and ingenious programming by their developers.

Participants of this challenge are required to give the best of their abilities in programming, robotics, electronics and mechatronics, but also to contribute on teamwork and knowledge sharing with other participants, regardless of culture, age or result in the competition

### **Design Construction and Programming have to be performed exclusively by the students**

Robots must be designed, constructed and programmed exclusively by student members of the team. Mentors, teachers, parents or companies should not be involved in the design, construction, assembly, programming and debugging of robots.

### **1. GAME PLAY**

#### **1.1 Game procedure and length of a game**

The RCJ Humanoid Soccer games consists of two teams of robots playing soccer against each other. Each team has two autonomous robots. The match lasts two equal periods of 10 minutes. Players are entitled to an interval at half-time. The half-time interval must not exceed 5 minutes.

#### **1.2 Ball movement**

**1.2.1** A robot cannot hold a ball. Holding a ball means taking full control of the ball by removing all of its degrees of freedom. Opposing robots must be able to access the ball.

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**1.2.2** A goal can be scored directly from a dropped ball. The procedure for dropped ball is the same as for kick-off, except that the robots of both teams must be outside the center circle. The ball is in play immediately after the referee gives the signal.

### **1.3 Incapable Players**

**1.3.1** Players not capable of play (e.g. players not able to walk on two legs, players not able to stand, or players with obvious malfunctions) are not permitted to participate in the game. They must be removed from the field. It is up to the referee to judge whether a player is capable of play.

**1.3.2** A field player that is not able to get back into a stable standing or walking posture from a fall within 30 seconds will be removed from the field for 30 seconds removal penalty and has to re-enter the field.

### **1.4 Scoring**

A goal is scored when the ball strikes or wholly crossed the goal line. Goals scored by either an attacking or a 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 received the goal against. Before a kick-off, all damaged robots are allowed to return to the playing field immediately if they are ready and fully functional.

### **1.5 Damaged robots**

If a robot is damaged, it has to be taken off the field and must be fixed before it can play again.

Computers and repair equipment are not permitted in the playing area during game play. Usually, a team member will need to take the damaged robot to an “approved repair table” near the playing area, located inside the competitors’ working area. A referee may permit

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robot sensor calibration, computers and other tools in the playing area, only for the 5 minutes before the start of each half.

Only the referee decides whether a robot is damaged. A robot can be taken off or returned only with the referee's permission.

### 2. The Number of Players

A match is played by two teams, each consisting of not more than two players, one of whom must be designated as goalkeeper. A match may not start if either team consists of less than one player.

### 3. TEAM

#### 3.1 Regulations

A team must have more than one member to form a RoboCup team to participate in the International event. A team member(s) and/or robot(s) cannot be shared between teams. Each team member needs to carry a technical role.

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. A team is allowed to have only the fewest possible members beside the field during game play: they will usually be the captain and an assistant team member.

#### 3.2 Violations

Teams that do not abide by the rules are not allowed to participate.

Any person close to the playing field is not allowed to wear any orange, yellow or blue clothes that can be seen by the robots (to avoid interference). A referee can require a team member to change clothes or to be replaced by another team member if interference is suspected.

The referee can interrupt a game in progress if any kind of interference from spectators is suspected (*e.g., clothing colors, camera flashes, mobile phones, radios, computers*).

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This needs to be proved to an OC member if a claim is placed by the other team. A team claiming that their robot is affected by colors has to show the proof/evidence of the interference.

### 4. The Design of the Robots

Robots must be programmed exclusively by student members of the team. Mentors, teachers, parents or companies should not be involved in the programming and debugging of robots.

For the programming of the robots, any programming language, interface or integrated development environment (IDE) may be used. The use of programs that come together with a commercial kit (especially sample programs or presets) or substantial parts of such programs are not allowed. It is not allowed to use sample programs, not even if they are modified.

Robots participating in the RC Humanoid Soccer League contests must have a human-like body plan. They must consist of two legs, two arms, and one head, which are attached to a trunk. The robots must be able to stand upright on their feet and to walk on their legs. The only allowed modes of locomotion are bipedal walking and running. All actions of the robots must be kinematically equivalent to humanoid motions.

#### 4.1 Robot Height and Width

$H_{top}$  is defined as the height of the robot when standing upright (with fully extended knees, body and head)

$$40 \text{ cm} < H_{top} < 60 \text{ cm.}$$

$W_{top}$  is defined as the width of the robot when standing upright (with fully extended hands)

$$W_{top} < 60 \text{ cm.}$$

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### **4.2 Robot Weight**

- The maximum weight for robots allowed to play is 5 kg.
- The minimum weight for robots allowed to play is 1.5 kg.

### **4.3 Sensors**

Teams participating in the RCJ Humanoid League competitions are encouraged to equip their robots with sensors that have an equivalent in human senses. These sensors must be placed at a position roughly equivalent to the location of the human's biological sensors.

1. Sensors, such as cameras and up to two microphones, may not be placed in the legs or arms or the torso of the robots. They must be placed in the robot's head and above any neck joint.
2. The field of view of the robots is limited at any time to 180 degrees. This means that the maximum angle between any two points in the overlap of the field of view of all cameras mounted on the robot must be less than 180 degrees. The pan-tilt motion of the head and the cameras mounted on the robot's head is restricted to be more human like not only with respect to the field of view but also to the range of motion of the neck joints. The mechanism to pan the camera is limited to 180 degree pan which means  $\pm 90$  degrees from the position looking straight ahead. The mechanism to tilt the camera is limited to  $\pm 45$  degrees (measured from the horizontal line).
3. The number of cameras is limited to a stereo vision setup (i.e., max. 2 cameras with a large overlap) only. Monocular vision is also allowed.
4. Touch sensors, force sensors, and temperature sensors may be placed at any position on the robot.
5. Sensors inside the robot may measure all quantities of interest, including (but not limited to) voltages, currents, forces, movements, accelerations, magnetic field and rotational speeds. They can be at any position inside the robot.

### **4.4 Communication and Control**

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**4.4.1.** Robots participating in the Humanoid League competitions must act autonomously while a competition is running. No external power supply, teleoperation, remote control, or remote brain of any kind is allowed.

**4.4.2.** Robots are not allowed to use any kind of communication during game play unless the communication between two robots is via Bluetooth class 2 or class 3 (range shorter than 20 meters) or via any other device that communicates using 802.15.4 protocol (*e.g., ZigBee and XBee*). Teams are responsible for their communication. The availability of frequencies cannot be guaranteed.

All other wireless hardware must be deactivated. A team may be disqualified if one of the team members violates this rule.

**4.4.3.** No humans are allowed on the field while the ball is in play. Robot handlers must receive permission from the referee prior to entering the field. The robot handler of a team may not touch a robot of another team in order to avoid any damage to that robot.

### 4.6 Robustness

Robots participating in the RCJ Humanoid League competitions must be constructed in a robust way. They must maintain structural integrity during contact with the field, the ball, or other players. Their sensing systems must be able to tolerate significant levels of noise and disturbance caused by other players, the referees, robot handlers, and the audience.

## 5. FIELD

### 5.1 Kind of field

There is only one kind of field for this league (regular RCJ Soccer field).

Kommentiert [1]: TBD

### 6.2 Dimensions of the field

The playing-field is 122 cm by 183 cm. The field is marked by a white line, which is part of the playing-field. Around the playing-field, beyond the white line, is an outer area of 30 cm width. The floor near the exterior wall includes a wedge, which is an incline with a 10 cm base and 2 cm rise for allowing the ball to roll back into play when it leaves the

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playing field. Total dimensions of the field, including the outer area, are 182 cm by 243 cm. It is recommended that the field be positioned 70 to 90 cm off the ground.

### 6.3 Walls

Walls are placed all around the field, including behind the goals and the out-area. The height of the walls is 22 cm. The walls are painted matte black.

Kommentiert [2]: TBD

### 6.4 Goals

The field has two goals, centered on each of the shorter sides of the playing field. The goal inner space is 60 cm width, 50 cm high and 20 cm deep, and box shaped. Nets are attached to the goals and the ground behind the goal, provided that they are properly supported and do not interfere with the goalkeeper. The mesh size for this net is suggested to be less than 4 cm in order to keep the risk of entanglement low. The upper side of the goal should not be covered by a net in order to allow for easy access to the robots from above.

The goal “posts” are positioned over the white line marking the limits of the field. The cross-bar is exactly over the white line. The interior walls, nets and the crossbar of each goal are painted, one goal yellow, the other goal blue.

## 7. BALL

Official ball is the passive orange ball. Balls for the tournament must be made available by the organizers. Organizers are not responsible for providing balls for practice.

### 7.1 Specification

The Technical Committee has been able to identify two balls that meet the technical specifications outlined below and are available worldwide. None of these balls have been marked official. That means it is not guaranteed that one of these balls will be used at the international event. However, the official ball will not be much different. These balls are:

A matte, hollow, orange ball, which can be obtained from:

- <http://schweikert-shop.hosting.de/index.php?cat=2259&lang=ENG&product=93011>

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The Mylec ball that was previously used in the Major category

- <https://www.amazon.com/Mylec-Weather-Bounce-Hockey-Orange/dp/B002LBDA30>

### **7.2 Diameter**

The diameter of the ball is required to be 65mm +/- 5mm. A well-balanced ball shall be used.