Rules for the RoboCup Humanoid League

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1. INTRODUCTION
This paper gives a brief introduction to the rules and regulations that govern the games of the Humanoid League (HL) in RoboCup. The HL made its debut at RoboCup 2002 and has been an interesting highlight of the event since then. The challenges in this league are different from other leagues. The main challenge in the HL is that the dynamic stability of robots needs to be well maintained while the robots are walking, running, kicking and performing other tasks. Furthermore, the humanoid soccer robots have to coordinate perceptions and biped locomotion, and be robust enough to deal with challenges from other players. The HL will be the main thrust for the Robocuppers to fulfil their dream of developing a team of fully autonomous humanoid robots that can win against the human world soccer champion team by the year 2050 [1].

2. THE PLAYERS
The game is played using biped humanoid robots. Robots in this league are caterized into three classes based on their height and the proportion of each part of the robot.

(i) H-40 class: the maximum permitted height of the humanoid \( H_{\text{max}} = 44 \) cm (in compliance with 10\% tolerance).
(ii) H-80 class: \( H_{\text{max}} = 88 \) cm.
(iii) H-120 class: \( H_{\text{max}} = 180 \) cm.

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Remark 1. The foot of the robot shall not overlap while standing and a rectangle shaped surface area (S) of each foot must satisfy: \( S < \frac{(H/3 \times H/3)}{2} \), where \( H \) is the actual height of the humanoid. A further restriction on the size of the surface of the foot will be given in the future.

Remark 2. With the eventual goal of developing fully autonomous humanoid robots in mind, performance factors will be allocated to each robot with regard to power source (internal/external), control platform (computer inside robot/external brain), human remote control/fully autonomous, etc. These factors are used as a penalty factor. In 2004, tele-operated/remote controlled robots will still be allowed. From 2005 onwards, only fully autonomous robots will be allowed.

3. THE FIELD AND THE BALL

The field is about 10.8 m long and 7.2 m wide. The colour of the field surface is green (green carpet used in the Mid-Size League will be adopted).

The ball specifications for the HL are the following:

(i) H-40 class: orange ball 83 mm, weight 26 g (same as the 4-Legged League).
(ii) H-80 class: orange ball 83 mm, weight 26 g (same as the 4-Legged League).
(iii) H-120 class: standard FIFA size 5 football, orange color (same as Mid-Size League).

4. THE GAMES

Currently, there are four challenges in the HL, i.e. standing on one leg, walking, penalty kicking and free style.

- **Standing still on one leg.** The robot shall stand on one leg for 1 min.
- **Humanoid walk.** The intention of this challenge is to evaluate the stable walking behavior of the humanoid. The robot shall be placed at a designated location in the field (see Fig. 1) and then walk along a defined course in the field. It should start from one end of the field, walk to the other end, turn round at the marker placed in the middle of the defense area and return to the initial position. Once the game has started, no human assistance shall be allowed to reposition the robot. Total time is measured, as well as the timing for each of the sectors. Sectors 1 and 3 measure the speed of the robot between the straight lines, and sector 2 measures the duration of the circular movement.
- **Penalty kick.** The field and its setting are shown in Fig. 2. Team A’s robot is placed behind the ball. Team B’s robot is placed in front of the goal. Team A’s robot will take on the role of kicker, and it shall walk and kick the ball to the goal. Team B’s robot will take on the role of goalkeeper. A session will finish once the goalie robot (Team B) has touched the ball or as soon as the ball has stopped within the
Figure 1. Humanoid walk field and time measurement points ($H_{ref}$ is the reference height referring to the value in the league name, e.g. 40 cm for H-40; $H$ is the actual height of the humanoid that is less or equal to $H_{max}$).

Figure 2. Humanoid penalty kick field.
marked goal field. If the ball is free (not touched by Team B’s robot), 60 s is allowed for the striker robot to attempt to score the goal. During this period, the session will finish whenever the goalie robot touches the ball. The goalie robot is not allowed to move out of the goalie position area for at least 5 s after the ball was initially touched by Team A’s robot. One game consists of five sessions for each team. If both teams have the same number of scores after five sessions, the session will continue until one team scores more goals than the other team. The roles between the teams are exchanged after each kick (e.g. striker and goalie).

- **Free style.** Five minutes will be given to each team for them to show any demonstration with their humanoid robots. Evaluation will be given by a panel that consists of seven independent jury members. Each jury member shall rate each demonstration, within a scale from 1 to 10 points, for (A) technical merit and (B) artistic impression. The highest score and the lowest score will be discarded, and the total points from the remaining jury are assigned as the overall score for the team.

*Remark* 3. From 2004 onwards, there will be some technical challenges in the HL.

5. **ROADMAP FOR THE HL**

A road map for the next a few years could be the following:
- 2004 — new challenges in the competition, e.g. balancing, passing and obstacle walk.
- 2005 — one versus one game, fully autonomous robots.
- 2006 — two versus two game, challenges on multiple objects tracking and collision avoidance.
- 2010 — challenges on cognitive issues.

Humanoid soccer robots are complex machines, which should have advanced abilities from very different fields of technology. In addition, it is noted that integration is one of the biggest challenges in the field of humanoid robotics. Whilst it is not difficult to build a vision system or implement mobility, it is hard to do all these things at the same time on the same robot with both high reliability and secure recovery procedures in the case of a subsystem failure.

The discussion for the rules for HL is still going on. Please refer to the RoboCup official website ([www.robocup.org](http://www.robocup.org)) for upcoming changes and developments.

**REFERENCES**