

HUROCUP

General Laws of the Game 2008

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April 25, 2008

Abstract

The following rules and regulations govern the game of HUROCUP, a robotic game and robotics benchmark problem for humanoid robots. HUROCUP attempts to encourage research into the many areas of humanoid robotics, especially walking and balancing, complex motion planning, and human robot interaction. The HUROCUP competition also emphasizes the development of flexible, robust, and versatile robots that can perform in many different domains. In addition to the single events (e.g., sprint, penalty kick, obstacle run, lift and carry, marathon, weight lifting, and basket ball), there is an all-round competition for the single robot that performs best over all events.

Latest Version of the Rules for HuroCup

The latest official version of the rules of the game for HUROCUP is always available from the FIRA HUROCUP website (<http://www.fira.net>).

1 Mission Statement

The goal of the HUROCUP league is to encourage research in practical, autonomous, highly mobile, flexible, and versatile robotic platforms. Intended applications for these robots are, among others, search and rescue robots, care robots, etc.

As a benchmark problem, the goal of the HUROCUP league is to develop humanoid robots that can perform several tasks in complex environments.

2 Changes in the Laws of HuroCup for 2008

In many respects, 2007 was a new start for HUROCUP, and many things changed. First and foremost, the old HuroSot name was changed to HUROCUP to better reflect the large and complex events that sit at the heart of HUROCUP.

2007 was the largest HUROCUP event ever with 20 teams participating at the FIRA/RoboGames events in San Francisco. Furthermore, the quality of the teams has greatly improved compared to previous years and new world records were set at this event. The team from Tamkang University in Taiwan managed to dethrone team Manus, from the National University of Singapore, which had one the competition from 2003-2006.

The 2007 event also introduced several new events into the all-round competition including weight lifting, marathon, and basketball. These events were well received. Predictably, lift and carry and obstacle run remained the most difficult events for the teams.

The aim of the rule changes for 2008 were to stabilize the competition after the major changes that were introduced in the previous year. Therefore, the introduction of the climbing wall competition was delayed until 2009.

Minor adjustments to the rules were made:

1. the robot dash event was renamed as the sprint event,
2. the robot must pick up a ball from a random position in front of it,

I hope that we will have another exciting competition which will lead to even more impressive research results and hope to welcome you all in Qingdao, China.

3 Physical Challenges

To reduce the steep learning curve toward fully autonomous humanoid robots, the rules committee has developed seven challenges for physical agents: (a) sprint, (b) penalty kick, (c) obstacle run, (d) lift and carry, (e) weight lifting, (f) marathon, and (g) basketball. These challenges are aimed at providing intermediate goals on the path to fully autonomous robots that can operate in difficult environments.

The following subsections describe each individual agent challenge. These challenges are conducted using the FIFA Laws of the Game (Section 4) as much as possible. Unless otherwise specified, the Laws of the Game apply.

3.1 Sprint

The sprint event (formerly named robot dash event) is a short distance race for humanoid robots. The goal is for the robots to move as quickly as possible from a start line to the end line for a series of segments. For detailed rules of the robot sprint event, please refer to the document titled “HUROCUP Sprint - Laws of the Game.”

3.2 Penalty Kick

In this event, the robot must approach and kick a ball positioned somewhere in the ball area. A robot from a different team will act as goal keeper during this event. For detailed rules of the penalty kick event, please refer to the document titled “HUROCUP Penalty Kick - Laws of the Game.”

3.3 Obstacle Run

This event is similar to the sprint event (Subsection 3.1). The robot must move from one end of the playing field to the other as quickly as possible. However, in this case, a number of obstacles are distributed over the playing field. The robot must navigate over, under, or around the obstacles and reach the end zone. For detailed rules of the sprint event, please refer to the document titled “HUROCUP Obstacle Run - Laws of the Game.”

3.4 Lift and Carry

The goal is to provide an event that requires robots to use active balancing. The robots will be fitted with a small basket. The robots repeatedly walk across an uneven terrain from one side to the other. Once the robot reaches the end of the uneven terrain, the referee adds small heavy obstacles into the basket. The robot must compensate for the extra weight and continue to cross the uneven terrain. to walk. The robot that can carry the most weight is declared the winner of the event. For detailed rules of the lift and carry competition please refer to the document titled “HUROCUP Lift and Carry - Laws of the Game.”

3.5 Marathon

The marathon event is an endurance race over 42.195m. The robots follow a coloured track. For detailed rules of the marathon event please refer to the document titled “HUROCUP Marathon - Laws of the Game.”

3.6 Weight Lifting

The goal of the weight lifting event is to develop robots that can lift and balance heavy weights. For detailed rules of the weight lifting event please refer to the document titled “HUROCUP Weight Lifting - Laws of the Game.”

3.7 Basketball

The basketball competition is another single robot event at the moment, but will be expanded to multiple players in the future. The robot must throw a ball into a coloured target. For detailed rules of the basketball event please refer to the document titled “HUROCUP Basketball - Laws of the Game.”

3.8 Soccer

The soccer competition is the first team event in the HUROCUP competition. It is a game of soccer played by teams of 3 players. For detailed rules of the lift and carry competition please refer to the document titled “HUROCUP Soccer - Laws of the Game.”

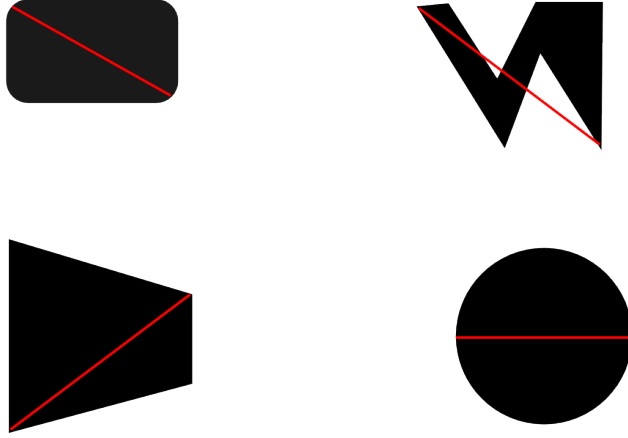


Figure 1: Four examples of the maximum foot dimension for different robot feet.

4 Laws of the Game

The following section describes the general law of the game for all HUROCUP events. It is based on the FIRA rules as well as the FIFA rules.

Law-1

The Players

- Law-1.1. The game is played using humanoid robots. The maximum size of the robots is 150cm. The maximum weight of the robot is 30 kg.
- Law-1.2. There are two categories of robots (small, and large) depending on their height and the maximum foot dimension.

The *height* of the robot is defined as the maximum distance between any part of the robot and the ground when the robot is fully extended.

The *maximum foot dimension* is defined as the maximum distance of any two points on any foot of the robot. Some examples are shown in the Fig. 1.

- *Small robots* are limited to a maximum height of 50cm and a maximum foot dimension of 14cm.
- *Large robots* must have a height of more than 80cm and are limited to a maximum height of 150cm and a maximum foot dimension of 35cm.

Law-1.3. The robot must be limited in its kinematics to actions that could be performed with human kinematics.

Law-1.4. The sensors on the robot must be equivalent to human sensors.

Law-1.5. The mode of locomotion of the robot must be bipedal walking or running.

Law-1.6. Each robot must have the ability of fully independent locomotion, sensing, and processing. That is, all actuators, motors, power, computing, and sensing mechanisms must be incorporated into the robot.

Law-1.7. Each robot must be fully autonomous, that is, it must perform its own control decisions.

Law-1.8. Before a game, each of the two teams has a color assigned, namely red or blue. Each team must be able to use either red or blue markers. The red team attacks the red goal and the blue team attacks the blue goal.

Law-1.9. Each robot must wear a team jersey with an assigned color (red or blue). The team jerseys are small vests made out of light material.

Law-1.10. In addition, robots may use black and white coloring without restriction. Other colors may be used so long as they are deemed by the rules committee to be sufficiently different from reserved colors, specifically ball yellow, marker red and marker blue.

Law-1.11. A robot must not have in its construction anything that is dangerous to itself, another robot, human operators, or spectators.

Law-1.12. For any infringement of this Law:

- play must be stopped,

- the offending robot as identified by the referee has to be removed from the playing field,
- the robot may be repaired and the fault identified by the referee may be corrected,
- the repaired robot may not re-enter the field without the referee's permission,
- the referee checks that the fault has been repaired before allowing the robot to re-enter the field,
- the robot may only re-enter the field if the ball is out of play.

Decisions

- Dec-1.1. The local organizing committee should make examples of possible vests available to the participants as soon as possible.
- Dec-1.2. The height of the robot includes all appendages such as sponsor markings, ornaments, antennas.
- Dec-1.3. The features of robots that are forbidden under Law-1.3 are special kicking devices on the foot, spinning upper bodies, or feet that can kick at a 90 degree angle.
- Dec-1.4. The restriction on the sensors of the robot will not be enforced until at least 2007. That is, robots are allowed to use infrared and other sensors without restrictions in the 2007 competition.

Law-2

The Referee

- Law-2.1. Every match is controlled by a referee who has full authority to enforce the Laws of the Game in connection with the match to which he has been appointed.
- Law-2.2. The referee
- (a) enforces the Laws of the Game,
 - (b) controls the match possibly in co-operation with the assistant referee,

- (c) ensures that any ball used meets the requirements of the laws of the game,
- (d) ensures that the robotic equipment meets the requirements of Law Law-1,
- (e) stops, suspends or terminates the match, at his discretion, for any infringements of the Laws,
- (f) stops, suspends or terminates the match because of outside interference of any kind,
- (g) stops the match if, in his opinion, a robot is likely to cause serious harm to humans, other robots or itself and ensures that it is removed from the field of play,
- (h) repositions the ball to a neutral position if it becomes stuck during play,
- (i) punishes the more serious offense when a robot commits more than one offense at the same time,
- (j) takes disciplinary action against robots guilty of cautionable and sending-off offenses. He is not obliged to take this action immediately but must do so when the ball next goes out of play,
- (k) acts on the advice of assistant referees regarding incidents which he has not seen,
- (l) ensures that no unauthorized persons enter the field of play,
- (m) restarts the match after it has been stopped,
- (n) provides the appropriate authorities with a match report which includes information on any disciplinary action taken against team officials and any other incidents which occurred before, during or after the match,
- (o) allows play to continue when the team against which an offense has been committed will benefit from such an advantage and penalizes the original offense if the anticipated advantage does not ensue at that time,
- (p) takes action against team officials who fail to conduct themselves in a responsible manner and may at his discretion, expel them from the field of play and its immediate surrounds.

Law-2.3. The decisions of the referee regarding facts connected with play are final.

Law-2.4. The referee may only change a decision on realizing that it is incorrect or, at his discretion, on the advice of an assistant referee, provided that he has not restarted play.

Law-2.5. A referee (or where applicable, an assistant referee) is not held liable for:

- (a) kind of injury suffered by an official or spectator,
- (b) any damage to property of any kind,
- (c) any other loss suffered by any individual, club, company, association or other body, which is due or which may be due to any decision which he may take under the terms of the Laws of the Game or in respect of the normal procedures required to hold, play and control a match.

This may include:

- a decision that the condition of the field of play or its surroundings are such as to allow or not to allow a match to take place,
- a decision to abandon a match for whatever reason,
- a decision as to the condition of the fixtures or equipment used during a match including the field and the ball,
- a decision to stop or not to stop a match due to spectator interference or any problem in the spectator area,
- a decision to stop or not to stop play to allow a damaged robot to be removed from the field of play for repair,
- a decision to request or insist that a damaged robot be removed from the field of play for repair,
- a decision to allow or not to allow a robot to have certain colors,
- a decision (in so far as this may be his responsibility) to allow or not to allow any persons (including team or stadium officials, security officers, photographers or other media representatives) to be present in the vicinity of the field of play,

- any other decision which he may take in accordance with the Laws of the Game or in conformity with his duties under the terms of the FIRA Federation or league rules or regulations under which the match is played.

Law-3

The Assistant Referee

Law-3.1. The assistant referee is appointed whose duties, subject to the decision of the referee, are to

- (a) act as timekeeper and keep a record of the match
- (b) monitor the robot operators for illegal signals being sent to the robots
- (c) indicate when an interchange is requested
- (d) indicate when misconduct or any other incident has occurred out of the view of the referee
- (e) indicate when offenses have been committed whenever the assistants are closer to the action than the referee (this includes, in particular circumstances, offenses committed in the penalty area)
- (f) indicate whether, at penalty kicks, the goalkeeper has moved forward before the ball has been kicked and if the ball has crossed the line

Law-3.2. The assistant referees also assist the referee to control the match in accordance with the Laws of the Game. In the event of undue interference or improper conduct, the referee will relieve an assistant referee of his duties and make a report to the appropriate authorities.