

HUROCUP: Lift and Carry

Laws of the Game 2007

Jacky Baltes
Autonomous Agents Laboratory
University of Manitoba
Winnipeg, Manitoba
Canada, R3T 2N2
Email: jacky@cs.umanitoba.ca
WWW: <http://www.cs.umanitoba.ca/~jacky>

January 4, 2007

Abstract

The following rules and regulations govern the Lift and Carry event in HUROCUP, a robotic game and robotics benchmark problem for humanoid robots.

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 Lift and Carry

The goal of this competition 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.

2 Changes in the Laws of HuroCup for 2007

The year 2007 marks a big change in the history of HUROCUP as it will be the inaugural competition for the HuroCup, which greatly increases the status and scope of humanoid robotics competitions within the FIRA framework.

3 Laws of the Game: Lift and Carry Competition

The following laws describe the specifics of the lift and carry event. For general specifications relevant to all HUROCUP events (e.g., robot dimensions, playing field and lighting, responsibility of the referees) please refer to the general HUROCUP laws.

LC-1

The Field of Play

- LC-1.1. The dimensions of the playing field are at least 180cm by 180cm.
- LC-1.2. An approximately 1.00m by 1.00m wide uneven terrain is placed by the referee in the playing field (See Fig. 1).
- LC-1.3. The uneven terrain consists of sheets of hard material such as corrugated plastic, corrugated cardboard, or wood.
- LC-1.4. The thickness of a single sheet is between 5mm to 10mm.
- LC-1.5. The uneven terrain is constructed by placing random cut-outs of the sheets on top of each other. The cut-outs may contain holes. The exact shape of the uneven terrain is determined by the local organizing chair.
- LC-1.6. The sheets are colour coded, that is sheets at different heights have different colours as shown in Fig. 2.
- LC-1.7. Teams may place small coloured or infra red markers in the goal area as long as they do not interfere with other teams.

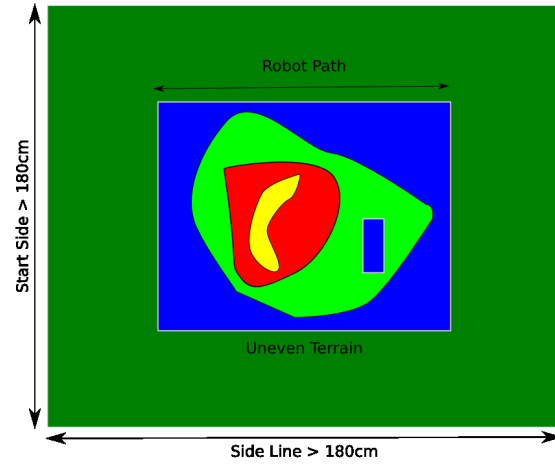


Figure 1: The field of play for the lift and carry competition. The task for the robot is to cross the uneven terrain repeatedly with increasing load.

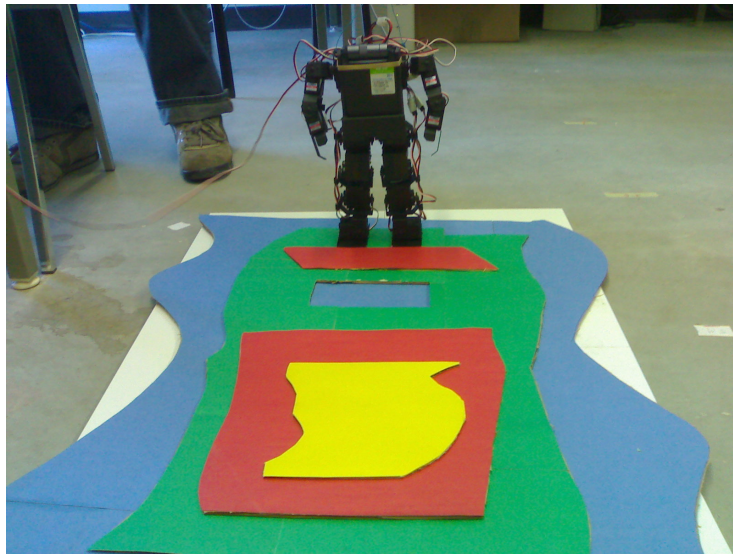


Figure 2: A sample uneven terrain

LC-2**Number of Robots**

LC-2.1. A single robot competes in a match.

LC-3**The Players**

Please refer to the general HUROCUP laws for a description of the players.

LC-4**The Referee**

Please refer to the general HUROCUP laws for a description of the referee.

LC-5**The Assistant Referee**

Please refer to the general HUROCUP laws for a description of the assistant referee.

LC-6**Game Play**

- LC-6.1. A single robot is designated the runner. All other robots must be outside of the playing field.
- LC-6.2. The only robot allowed to move during a run is the designated runner.
- LC-6.3. The runner must be fitted with a small basket or bucket (see Fig. 3 for an example), which is able to hold as many batteries as the team wants the robot to carry.
- LC-6.4. The runner will be placed at one end of the uneven terrain in the middle of the terrain.
- LC-6.5. At the beginning of the competition, the referee will place one weight in the basket attached to the robot.
- LC-6.6. The referee will signal the start of the competition by blowing the whistle.
- LC-6.7. After the referee gives the start signal, the robot must cross the uneven terrain to reach the other side.
- LC-6.8. A robot is not allowed to leave the uneven terrain along the sides.
- LC-6.9. Each robot may have at most one human handler associated with it.
- LC-6.10. The human handlers are not allowed to interfere in any way with other robots, the referee, or other human handlers.
- LC-6.11. A human handler may only enter the playing field or touch his/her robot with the permission of the referee.
- LC-6.12. The end of the competition is signaled by the referee by blowing the whistle a second time. The referee terminates the competition if



Figure 3: A suitable basket for the lift and carry challenge on the right and suitable weights (Standard AA batteries) in front. Such a basket must be fitted to the robot before the lift and carry challenge. A standard 591ml soft drink bottle is shown for comparison. The basket in the picture was constructed by cutting the bottom off the soft drink bottle.

- the robot has crossed the uneven terrain with a maximum load,
- the robot was unable to cross the uneven terrain within 2 minutes,
- the robot falls and is unable to get up on its own or is immobilized by a technical defect,
- the robot leaves the uneven terrain along the side lines,
- at least one minute has elapsed since the start of the competition and it is unlikely in the opinion of the referee that the robot will cross the finish line within the remaining time.

LC-6.13. At the end of the run, another robot will be designated the runner.

LC-7

Method of Scoring

LC-7.1. Any robot that has not crossed the uneven terrain at least once is automatically awarded 0 rank.

LC-7.2. Among the robots that have crossed the uneven terrain at least once, the robots are ranked (i.e., 1st place, 2nd place) based on the greater number of batteries carried.

LC-7.3. The point allocation for robots is as follows:

Place	Points scored
1 (Winner)	10
2	8
3	6
4	4
5	3
6	2
7	1
8, 9, ...	0

Table 1: Point allocation for placings in the HUROCUP events.

- The first ranked robot is awarded 10 points.
- The second ranked robot is awarded 8 points.
- The third ranked robot is awarded 6 points.
- The fourth, fifth, sixth, and seventh place robots are awarded 4,3,2, and 1 point respectively. A summary of the point allocation for placings is shown in table 1.

LC-7.4. In case of a tie between n robots with rank k , all robots will be awarded rank k and receive the average of the scores for ranks k to $k + n$. For example, if the robots A, B, C, D scored 10, 8, 8, 4 goals respectively, then robot A will be declared the winner (1st place) and receive 10 points, both robots B and C will be declared 2nd place finishers and receive $(8 + 8)/2 = 8$, and robot D will be declared the fourth place finisher and receive 4 points.

Decisions

Dec-7.1. For the 2007 competition, the technical committee decided that in addition to the restrictions given above, the uneven terrain includes the following simplifications:

- The uneven terrain will only contain steps wich move one level up or down.
- The minimum distance between edges of the sheets is 5 cm.

These additional constraints are targeted at simplifying the lift and carry competition over uneven terrain.