Technical Challenges for the RoboCup 2004 Legged League Competition

June 27, 2004

1 Introduction

There are three technical challenges that will be held at the RoboCup 2004 Legged League Competition. They are:

- The Open Challenge (Section 2)
- The Variable Lighting Challenge (Section 3)
- The almost SLAM Challenge (Section 4)

and are described in detail in the following sections.

2 The Open Challenge

This challenge is designed to encourage creativity within the Legged League, allowing teams to demonstrate interesting research into autonomous systems. Each team will be supplied with three minutes of time on the robocup field to demonstrate their research. Each team may also distribute a short, 1 page, description of their research. The winner will be decided by a vote among the entrants. In particular:

- Teams must describe their demonstration to a designated representative of the organising committee at least one day before their demonstration.
- Each team may use any number of Sony AIBO robots. Teams must arrange for their own robots.
- Teams have three minutes to demonstrate their research. Any setup or removal time shall be counted as part of that three minutes. Any demonstration deemed likely to require excessive time may be disallowed by the organising committee.
- Teams may use extra objects on the field. No non-AIBO robots may be used.

- The demonstration must not mark or damage the field. Any demonstration deemed likely to mark or damage the field may be disallowed by the organising committee.
- The demonstration may not use any offboard sensing or actuators, or modify the AIBO robots.
- The demonstration may use off board computing power connected over the wireless LAN. This is the only challenge in which off board computation is allowed.
- The demonstration may use off board human-computer interfaces. This is the only challenge in which off board interfaces, apart from the GameController, are allowed.

The winner will be decided by a vote among the entrants using a Borda count (`http://en.wikipedia.org/wiki/Borda_count`). Each entering team will list their top 10 teams in order (excluding themselves). The teams are encouraged to evaluate the performance based on the following criteria: Technical strength, novelty, expected impact, and relevance to RoboCup. At a time to be decided by the designated referee, within 30 minutes of the last demonstration if not otherwise specified, the captain of each team will provide the designated referee with their rankings. Each ranking is converted to points: 10 points for top ranking, 9 for second, down to 1 point for 10th. Any points awarded by a team to itself will be disregarded. The points awarded by the teams are summed. The team with the highest total score shall be the winner.

3 The Variable Lighting Challenge

This second challenge is intended to encourage teams to increase the robustness of their vision to lighting changes. It is based on a penalty shoot out. The team attempting the challenge places a single blue robot on the field. That robot must score as many goals as it can into the yellow goal in three minutes. The team that scores the most goals wins. If two teams score the same number of goals, then the team with the lowest average time to score each goal wins (Note: this is the same as choosing the team who scored their last goal earliest). If no team scores, then the team with the ball closest to the goal at the end of their time wins.

As well as the single blue robot, there are two red 'opposition' robots on the field. Both of these robots are paused; frozen in the 'UNSW stance'. One is placed in a goalie position on one side of the yellow goal. The other is placed in the third of the field nearest the yellow goal, at least 30cm away from the edge. The exact locations of these robots are to be determined by the referee, and will be the same for all teams. See Figure 1.

There is a single ball upon the field. Initially it is placed in the centre kickoff position. Upon each score, the ball is moved back to the centre kickoff position.

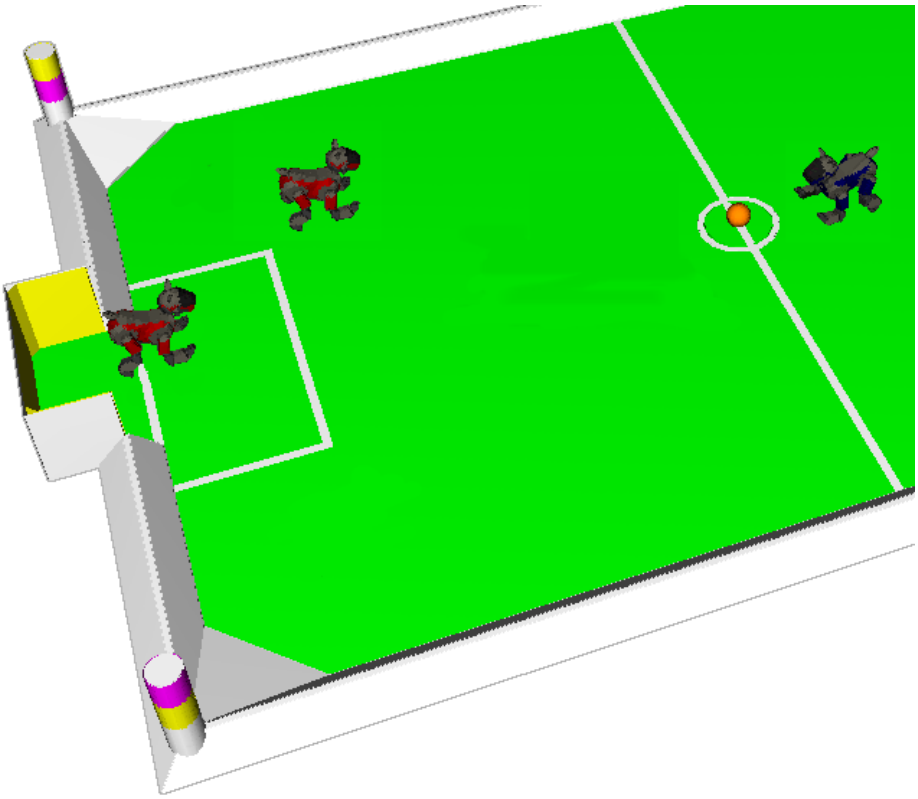

Figure 1: An example placement of opposition robots for the variable lighting challenge

The robot is not moved by the referee and must make its own way back to the centre of the field to reach the ball again. The robot will receive a message from the game controller with its new score.

The lighting for this challenge is also different from standard robocup lighting. Some additional lights are brought in to supply variable lighting conditions (we envisage variable strength lighting such as theatrical lighting). These additional lights shall be 'white' light of deliberately unspecified colour temperature. Lights may also be covered to achieve variable lighting conditions.

Before the challenge the referee shall prepare a schedule of lighting changes. It shall include periods of relative stability in the lighting, periods of slow change in lighting and periods of fast change in lighting. It is envisaged that the additional lighting will be non-uniform across the field and hence the lighting changes will be non-uniform. This lighting schedule will be the same for all teams, but unknown before the challenge.

Unless otherwise specified, normal penalty shootout rules apply. There will be no penalty for charging the 'opposition' robots, however neither is a team is not allowed to help its robot stop charging, move away from or around another robot.

4 The almost SLAM Challenge

The almost SLAM challenge is intended to help the league move away from strictly defined beacons to more generic localization information such as the various stands in a soccer stadium. In order to achieve this, additional landmarks are placed around the fence on a robocup field. The challenge then consists of two stages. In the first stage, the robots are given time to explore the field. In the second stage, the normal beacons and goals are covered up or removed, and the robot must then move to a series of points on the field.

These additional landmarks have the following constraints:

- They are all outside the field, and inside the outer barrier
- They are of varying size and colour
- They are guaranteed to be unique when colour and orientation are taken into account
- There will be at least three of these landmarks containing a patch of pink at least 10cm across
- There will be at least six landmarks
- They will be at least 15cm apart
- They will contain no white or black
- Each dimension will be between 10cm and 50cm

- They will be at least 10cm above the field, and no more than 50cm above the field

Before the challenge the referee will choose appropriate landmarks, and five points on the RoboCup field. The selected points are written to each team's stick in a text file located at /MS/points.cfg. The format of the file has one target point per line, the x coordinate followed by the y coordinate. There is an example file available at `http://www.openr.org/robocup/challenge2003/points.cfg` and shown in table 1. Note that this is the same file format as the localization challenge in 2003. The file describes the positions as shown in Figure 2 marked by three circles. The coordinates are given in cm, and the origin of the system of coordinates is the centre of the field. The x-axis points from the blue goal (negative x) to the yellow goal (positive x). y-coordinates on the right of this axis are negative, on the left they are positive. Each team is responsible for writing code to read this file. Points are guaranteed to be at least 15cm from the nearest obstacle, and at least 100cm from any other point.

```
-210␣0
-100␣50
50␣-100
160␣100
180␣-30
```

Table 1: An example points.cfg for the second challenge

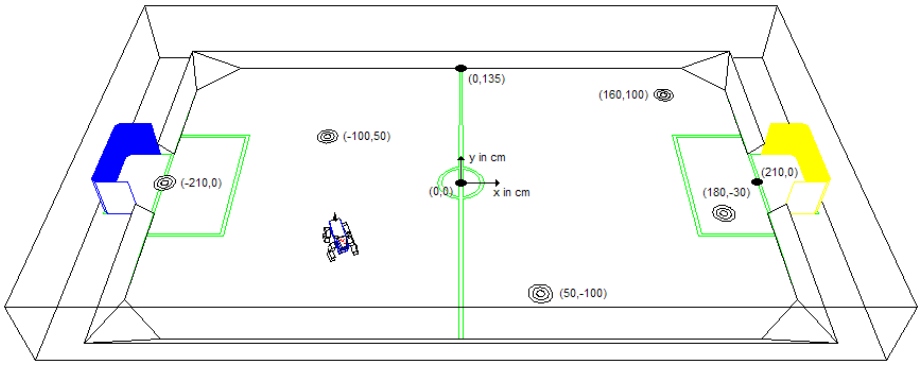

Figure 2: The challenger and the five target positions given in the example file for the SLAM challenge

In the first part of the challenge, all normal landmarks and the additional landmarks are uncovered. The robot performing the challenge must start paused. The referee will place the robot in the centre of the field and then activate the

robot by touching its head sensor. The referee will then leave the field area. The robot shall move about the field for less than one minute. It will then pause itself.

Between the two parts of the challenge, the referee will cover or remove all of the normal landmarks and goals. The referee will move the robot towards the centre of the field so that it is at least 50cm away from the nearest target point. The referee will then activate the robot by pressing its head sensor and start timing.

Upon activation, the robot will start moving to one of the points. When it is close to the point, the robot will pause itself and indicate to the referee that it believes it is near a point (usually by wagging its tail). At this point the referee will pause the timer, place a small marker underneath centre of the robot, and then re-activate the robot and re-start the timer.

The second stage ends when the robot has had 2 minutes, or when it has stopped five times. At the end of the second stage, all robot position markers more than 50cm from any field point are disregarded, and if there are multiple markers within 50cm of a single point then only the closest is kept. Teams are then awarded $150 - d$ points for each visited marker, where d is the distance from the marker to the point in centimetres. They are then awarded $5(120 - t)$ points, where t is the total time used in the second stage measured in seconds. Tables 2 and 3 shows some examples of this scoring method.

Teams will be ranked as follows: First, they will be ranked by the number of markers they reach (within 50 cm). When two teams reach the same number of markers, the score determines their rank.

Another way of looking at the scoring is as follows:

- You start with 600 points.
- You lose 5 points per second.
- You get 100 points for reaching a marker (within 50cm). At 5 points per second, this means you need to reach that 50cm circle within 20 seconds to make it worth your time.
- For each 1cm you improve your accuracy you get another point. At 5 points per second, this means you need to increase your accuracy at 5cm/s to make it worth your time.

Imagine we have the 5 target points in Table 1. And the robot stops at these locations in 45 seconds:

Mark	x	y	d	score
1	-210	5	5	145
2	-100	110	60	0
3	55	-90	11.2	138.8
4	160	100	0	150
5	175	-30	5	145

Total distance score = 578.8
Time score = 375
Total score = 953.8

Table 2: An example set of scores for the SLAM challenge

If you don't get within 50cm of any marker, but take 5 seconds, then your score is:
Total distance score = 0
Time score = 575
Total score = 575

Table 3: An example set of scores for the SLAM challenge