French LRP Team's Description

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Abstract. This paper describes the problems encountered in vision by the French team in RoboCup2000. Since the participation of LRP in 1998, the team has focused on the 3 following topics: locomotion, vision and strategy. In RoboCup 1999 in Stockholm, Sweden, we carefully designed the locomotion patterns [1][2][3] to make the robots walk as fast as possible. We also implemented some trajectory correction while walking. In RoboCup 2000 in Melbourne, Australia, our team tried to improve the vision system to see better and farther. We also focused on adding some special strategy features to improve the robots' behavior.

1 Introduction

From the beginning (RoboCup 98, exhibition of legged league in Paris), the French team has decided to code its own algorithms for locomotion and vision. This has proved very useful because it is possible to master every detail of the computation. The French team got the 2nd place in 1998, became champion in 1999 and finished second in 2000. After the victory in 1999 against the UNSW team, it was clear that it would be very difficult to defend our title the following year. We did not improve our walking patterns very much. The vision system designed in 1999 was enhanced thanks to special high-level filtering. However lighting conditions were not satisfactory for our vision system to show its best performances. In fact, that is the strategy that played a significant role in our second place [4]. In this paper, the first section deals with locomotion. The second section is devoted to the vision system and the last section describes the special behaviors designed to play the final.

2 Locomotion

Since our locomotion patterns were successful in 1999, why not reuse them in RoboCup 2000? We reused them and tried to add some improvements to avoid situations of falls. Falls may occur when the robot starts to walk on the inclined wall that makes the border of the field, when it bumps into another robot, or when he crosses the separating line between the goal and the green carpet (the goal floor is made of plastic and is more slippery than the carpet). To prevent from falling, we tried to detect the collision and trigger some reflex movements.

P. Stone, T. Balch, and G. Kraetzschmar (Eds.): RoboCup 2000, LNAI 2019, pp. 615-618, 2001.

However it appeared that detection of collision was very difficult to achieve. As a matter of fact, either there were some non-desired detections, or detection was not so reliable (50% of falls remaining). In case of non-desired detections, the robot was often suddenly interrupted in its strategy of attacking the ball and consecutively lost a lot of time, which was not acceptable for a soccer game. The case of non reliable detection did not bring a significant improvement in the behavior. We decided not to use it in the matches after the training tests.

3 Vision

In 1999, our vision system was fairly reliable, and our robots were able to see the ball within the range between one third and one half of the field length. Detection was based on the hardware color detection table (CDT) that equips the Sony quadrupeds. Thanks to optimized computation, the image processing rate was 20 images per second. This was possible by implementing low level filtering similar to an opening procedure. The main objectives for RoboCup 2000 were to increase the range of sight of the ball and the markers around the soccer field, and to run at video rate. For this purpose we focused on the two following points: how to automatize the tuning of the CDT (selection of threshold parameters), and how to design new low level filtering.

3.1 The different confusions

Paradoxically we encounter more problems in vision than last year. The ball was smaller, shiny. In addition, lighting conditions were bad compared to RoboCup 1999. We suspect that a lot of confusions come from the fact that the soccer field was unequally illuminated.

1. The first type of confusion is the confusion between two landmarks (a landmark is composed of two piled blocks of different colors among yellow, blue, pink and green) when the ball is near one of them with pink bottom (see Fig. 1). In fact the orange of the ball is seen as a yellow color, and all the markers with pink bottom on one side can be mistaken for the pink-yellow marker on the corner of the opposite side. A very bad consequence of this is that the robot can take the wrong direction and push the ball towards its own field.
2. The second type of confusion is most classical. The orange of the ball is confounded with the yellow color of one of the goal. The first consequence of this is that the robot sometimes sees a ball inside the side walls of the yellow goal. This comes from shadows of side walls that darken the yellow color of part of the side walls. The second consequence is that the robot may see the yellow goal inside the ball ! This may be due to the brightness on the top of the ball.

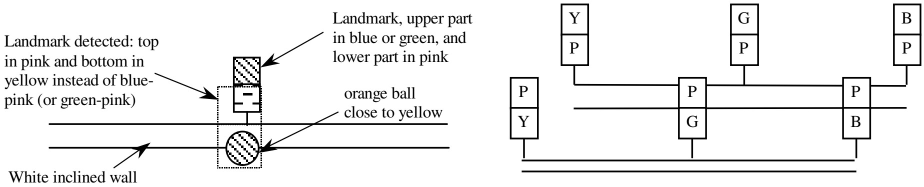

Fig. 1. Left: marker-ball colour confusion. **Right:** right and left length sides of the soccer field. The yellow goal is located between the yellow-pink (Y/P) and pink-yellow (P/Y) markers. The blue goal is the opposite one. The pink color at the bottom of one of the marker and the orange of the ball near the marker are confounded with the pink-yellow marker on the other side of the field. This is due to orange-yellow confusion.

3.2 On improving the vision system to avoid confusion

In 1999, the tuning of the CDT parameters required some expertise from the user. For RoboCup 2000, we designed new functionalities for our tuning interface to allow users who were not experienced in image processing to do the job of tuning. The new features added were based on cooperative multi-spectral edge/region segmentation. However due to bad lighting conditions and brightness on the ball we had to restrict the areas inside the objects to detect in the image. Tuning of parameters appears to be more difficult than expected. We also developed low level filtering procedures with various degree of filtering, similar to *mathematic morphology* procedures. The advantage of these filters is that they can be processed at video rate together with the extraction of connected components during the same image scanning. However, because these filters reduced the range of sight of the ball, they were replaced by high level filtering procedures during the competition. Unfortunately, two many cases of confusion appeared, and it was not possible to deal with all of them. In the same time, we carried out some segmentation procedures in simulation without using the CDT. They gave better results. One conclusion we can draw from this experience is that teams who used the CDT got more problems than teams who decided not to use it.

4 Behaviors

4.1 Special features

In RoboCup 2000, our team added some special features to the behaviors of the different players. Like other teams we developed a kind of shoot where the robot clears the ball by plunging forward with both front legs stretched. Moreover, the goalkeeper was given the capability to drop on the floor with legs stretched sideways to stop a ball that would go too close and too fast towards the goal. However this technique was not the best one against robots that made pressure near the goal. In addition, it was not reliable since it was difficult to evaluate the speed of the ball because of vision confusion. We opted for a better strategy that consisted for the goalkeeper in clearing the ball as soon as the ball crossed the penalty line. The robot should shoot into the ball and keep on clearing it as long as it was in its field of sight. The goalkeeper was a kind of *flying* goalkeeper. The technique was fairly efficient but the robot sometimes missed the ball when shooting because of bad implementation.

4.2 Localization

In case the robot was lost and could not spot the ball after a certain time, the strategy module was designed to run a localization procedure. This procedure made the robot halt, scan and turn-in-place until capturing 3 different markers for triangulation localization. We used 3 landmarks because we thought that information of distance was not so accurate. However, during the final we disabled this feature since it took too much time. Instead of running the localization procedure, the robot was designed to go back to its own goal to defend. This was very useful since an attacker could assist the goalkeeper. However the rule of *no more than one defender inside the penalty area* penalized us very much. We did not count how many times the referee picked up our defender robots that were coming back to help defending !

5 Conclusion

A lot of work remains to be done in vision. Without significant improvements in this domain, we think that it is not possible to design cooperation between robot partners, unless wireless communication inside the same team is allowed in next RoboCup. Some other teams like CMU have made some significant developments in vision that allow them to achieve very good performances in terms of localization on the field [5]. However, one robot spotting the other ones on the field with enough accuracy is still very difficult to achieve.

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