MCT Susano Logics 2015 Team Description

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Abstract. This paper describes both defense and offense strategies, and a newly developed omni-wheel of MCT Susano Logics. We introduced a man-to-man defense to the defense and an autonomous pass play and screen plays to the offense. An omni-wheel with 26 small disks was developed to improve the running performance of the robot.

1 Introduction

Susano Logics tried to use our new defense strategy of man-to-man defense at the games in RoboCup 2014. The defense strategy worked well, but the running performance of our robots were poor, and our offense strategy was not good, so we won only a game. We brushed up our both defense and offense strategies and developed a new type omni-wheel to improve the running performance of the robot.

2 AI Strategies

We introduced basketball strategies to our AI program to get shooting and passing opportunities. The SSL game is similar to basketball game because the number of the player is same besides the goalkeeper. Players in both games use passes rather than dribbles to carry a ball. The non-kinematic basketball techniques seemed to be easy to adopt for our game strategies.

2.1 Man-to-man defense

In our previous defensive strategy, a goalkeeper was placed in the defense area and 2 robots stayed just outside the defense area to defend opponent's shoot. The other robots ran to the ball to possess it. The robots near the defense area did not serve in the game when a ball position was far from our goal.

For the quick turning to offense formation, we adopted a defensive strategy to a man-to-man defense that is the primary defense technique in the basketball. On the basketball man-to-man defense scheme, a defender stands and faces at between an opponent player and the basket. On our man-to-man defense scheme, we assigned all robots but a goalkeeper to the man-to-man defenders. A defender transfers to between a opponent robot and our goal to block a shooting opportunity to our goal.

Figure 1 shows our man-to-man defense. The goalkeeper stays in our defence area and goes on a line which connects the ball and the center of our goal. Each defender goes on the line of connecting an opponent robot and the center of the goal.

The distance between the opponent robot and the defender sets L_2. Where, L_2 is a length function of L_1, which is the length between the opponent robot and our goal. Alpha is a proportional constant.

$$L_2 = \alpha * L_1 \tag{1}$$

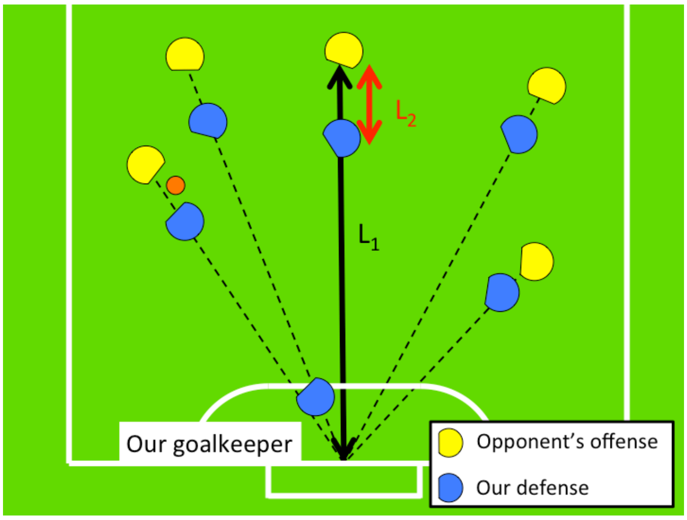

Fig. 1. Man-to-man defense

Our AI decides the ball possession by the nearest robot from the ball. When the nearest robot from the ball is an opponent, our AI selects the defensive strategy. In another condition, the AI changes the strategy to offensive.

2.2 Offensive strategy

Our offensive strategy consists of a pass play and screen plays. When the ball stays in our team's territory, the AI use the pass play to gain the field. When the ball crosses the halfway line, the AI uses the screen plays.

Pass play In our offencive term, we assign all robots except a goalkeeper to attackers.

Figure 2 shows our pass play to carry the ball to the opponent's side. First, a passer goes to the ball and other attackers move to each specified position. L_0 is a distance between the ball and the center of the opponent's goal. Each distance between an attacker and the ball sets $L_n(n = 1, 2, 3, 4)$. Equation 2 shows the length of L_n.

$$L_n = \beta * L_0 \quad (n = 1, 2, 3, 4) \tag{2}$$

Where, β is a gain to avoid obstacles. The angle θ is also a function of L_0.

$$\theta = \gamma(8 - L_0) \tag{3}$$

The AI places 2 robots to the right side of the line to the goal and other 2 robots to the left side. If a specified position goes outside the field, the AI changes the position to the other side. In Fig.2, the position of robot No.1 is outside, the AI changes the position to No.1'.

On some team's strategy, 2 defenders are in front of the defense area, so the maximum number of the defender who defend a pass from the passer is 3. So at least one visible attacker will be in the field. The passer passes the ball to our visible robot. After the pass, the visible robot who receives the ball becomes next passer. The others go to next specified positions. Our robots carry the ball to opponent's side by this algorithm.

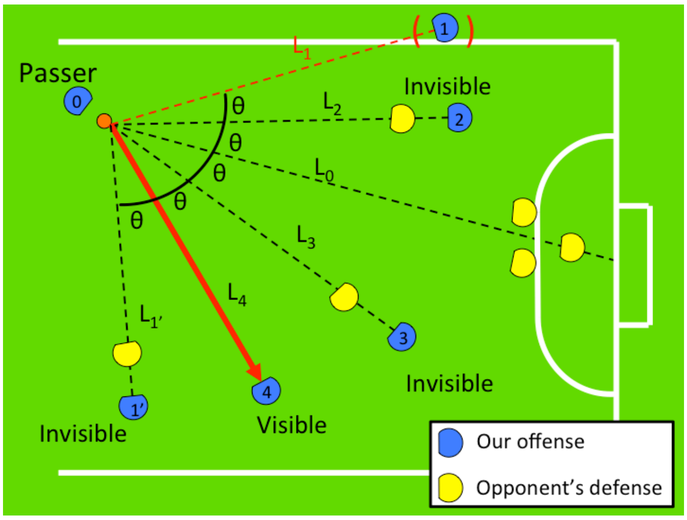

Fig. 2. Pass play

Screen plays In the basketball, a screen play is a blocking motion by offensive players. The motion enables teammates to shoot or to receive a ball, by restricting defender movements.

Figure 3 shows our screen play. First, a passer tries to pass the ball to a receiver. The passing route is blocked by a defender who stays between the ball and the receiver. Next, the screener moves to near the defender in order to screen the defender movement. At the same time, the receiver moves to a effective receiving position. The defender movement is restricted by the screener, so the receiver is able to receive the ball.

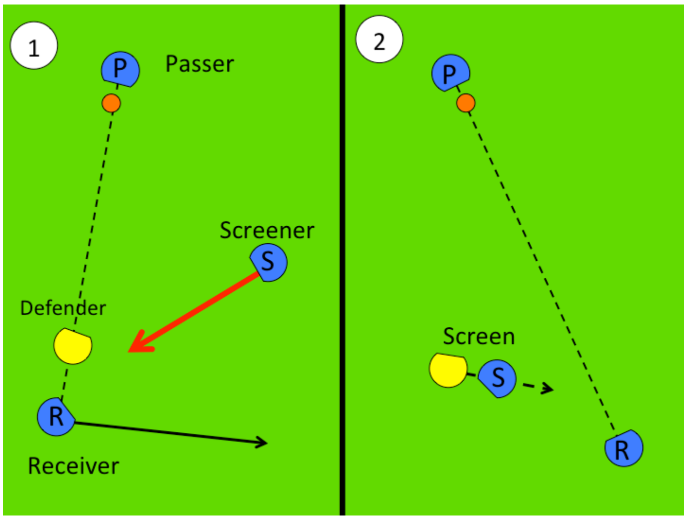

Fig. 3. Screen play

3 Robot hardware

To improve the running performance of our robots, we designed a new omni-wheel with dual inline disks. Figure 4 (a) shows the structure of our former omni-wheel with 15 small disks. The small disk was composed of two ball bearings with flanged outer rings covered with 2 o-lings. The diameter of the bearing with the o-ling was 9.5 mm. and the width of the 2 bearings was 5.4 mm. The structure was simple but the number of disk was limited because of the width of the disk. The vertical pitch caused by the ground touching of the disks caused a skid which deteriorated maximum acceleration rate and the ability to hold a straight line.

Figure 4 (b) shows our newly designed omni-wheel with 26 urethane mold bearings. The diameter of the bearing was 9.0 mm. and the width was 3.0 mm. We designed the wheel in order to minimize the vertical pitch for maximizing the number of the disk.

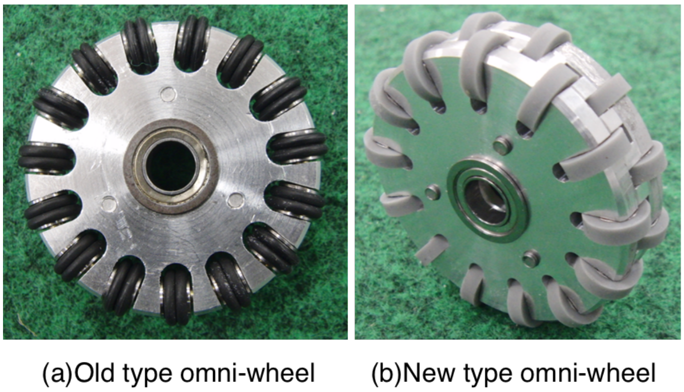

Fig. 4. Wheel structures

Figure 5 displays the speed response of the robot with the old omni-wheel and the new one. The command of acceleration rate was 1.3 m/s^2 and the maximum speed was 2.0 m/s. The acceleration of the robot with new wheel showed about 1.1 m/s^2 which was about 10 percent better than the old type.

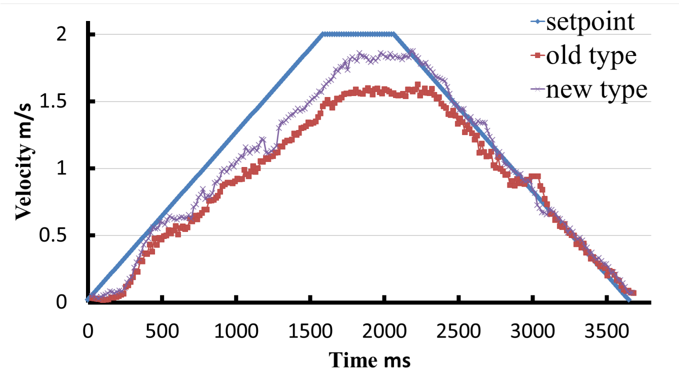

Fig. 5. Speed responses