Development of the Estimate of Computer Assistance Program for Checkmark Position by Different Bend Radius of Curvature of Different Lanes in 4x100m Relay

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Abstract. This study aims to discuss the effect of radius of curvature on the checkmark in different lanes of 4×100m relay and offer appropriate suggestion of checkmark according to the speed of different runners. The objects of research were sixteen outstanding players of senior high school and college who had accepted the long-term training in 4×100m relay. The research obtained the interval time of checkmark calculation of each runner in 130m to calculate the interval speed by SPM100. This study found that the forecast formula of bend speed developed by Greene in 1985 could be used in present PU track, thus we applied it to substitute the actual measurement. Experimental checkmark was calculated from the interval speed of incoming runner in last 30m and the starting speed of outgoing runner in 30m. Traditional checkmark was the original used distance. Both of them had the obvious differences ($P< .05$). Hence, the two checkmarks had different results. Comparing the individual grade, the grades of experimental checkmark were better than the grades of traditional checkmark. Therefore, the estimate of computer assistance program for checkmark position by the different bend radius of curvature of different lanes in 4×100 m relay could be applied to the real competitions which can provide the runners and coaches as prompt references, which expect to reduce the possibility of mistakes of baton exchange and let relay process more easily completed.

Keywords: checkmark, takeover zone, 4×100m relay, bend, computer assistance program.

1 Introduction

1.1 Research Background

The set of the checkmark position is affected by the speeds of the incoming and outgoing runners. The speed is divided into two parts, namely the linear speed and the bend speed. According to the scientific theory, the bend speed is affected by the bend radius of curvature and the linear speed, but all three takeover zones cover the bend part, and the different lane has the different bend radius of curvature(please refer to Fig. 1). Therefore, the bend radius of curvature is recognized as an important factor

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that may affect the set of the checkmark position, and will be also an important uncontrollable condition that will affect the baton exchange.

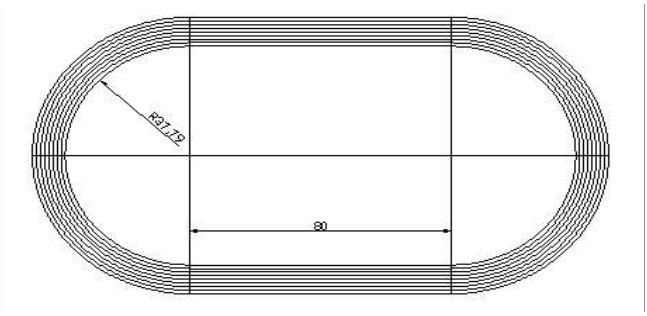

Fig. 1. Typical track and field stadium of double semicircle

1.2 Research Objectives and Problems

This study aims to discuss the effect of radius of curvature on the checkmark in different lanes of 4×100m relay and offer appropriate suggestion of checkmark according to the speed of different runners.

2 Research Methods

2.1 Test Subjects

The subjects of research were sixteen outstanding players of senior high school and college who had accepted the long-term training in 4×100m relay. Their age, height, mass were 19 ± 2.9yr, 170.6±6.9cm, 59.6 ± 8.8 kg, separately.

2.2 Research Process

- Measurement of the Interval Speed

The research obtained the interval time of checkmark calculation of each runner in 130m to calculate the interval speed including the first 30m and the last 30m linear speed and bend speed by SPM100(please refer to Fig.2 & Fig.3).

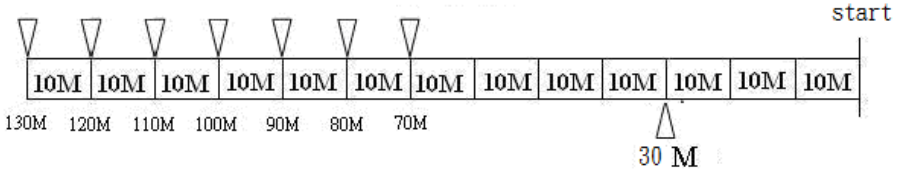

Fig. 2. Positions of the interval time of checkmark in experimental set-up

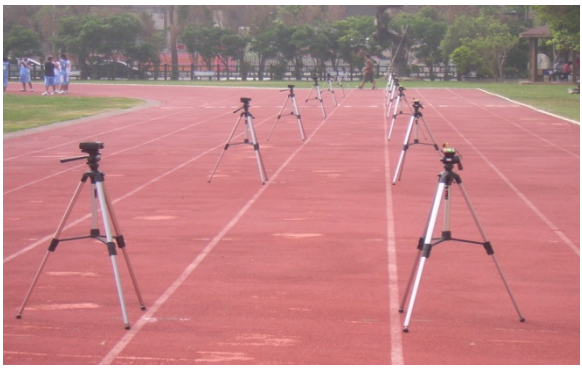

Fig. 3. Positions of the SPM100 in experimental set-up

- Estimate of Bend Speed

According to the results of Greene in 1985：

$$\omega = \left[\frac{r^2}{2} + \sqrt{\frac{r^4}{4} + \frac{r^6}{27}}\right]^{\frac{1}{3}} + \left[\frac{r^2}{2} - \sqrt{\frac{r^4}{4} + \frac{r^6}{27}}\right]^{\frac{1}{3}} \tag{1}$$

$$r = Rg/V_0^2 \tag{2}$$

$$V = V_0\sqrt{\omega} \tag{3}$$

(g：9.8m/s^2；R： bend radius of curvature；V_0 ： linear speed ； V ： bend speed)

So, we could get the estimate of bend speed for the specific lane.

- Calculation of The Experimental Checkmark

In this experiment, the position of the baton exchange was set at 3m from the end of the takeover zone, and in this moment, the free space between outgoing and incoming runners was 1.5m. Experimental checkmark was calculated from the interval speed of incoming runner in the last 30m and the starting speed of outgoing runner in the first 30m. So, we get the formula for checkmark position:

$$D = (27/V_2) * V_1 - 25.5 \tag{4}$$

(D：the position of the experimental checkmark from the outgoing runner； V_1：the estimate of bend speed of incoming runner in the last 30m；V_2：the estimate of bend speed of outgoing runner in the first 30m)

Traditional checkmark was the original used distance.

2.3 Data Processing

The Relay team randomly selected two different lanes, and performed two 4X100 m relay using experimental Checkmark and traditional checkmark, respectively. The grades were analyzed and tested for significance via paired-sample t-test ($\alpha = .05$).

3 Results and Discussion

3.1 Comparison between Estimate and Actual Measurement of Bend Speed

In this study, we measured the linear speed and the bend speed in the 30m actually. We found bend radius of curvature are still major factors influencing the bend speed just like mentioned by Chang, Campbell, and Kram [1] [2]. Research results show that there were no significant differences between estimate and actual measurement of bend speed ($p > .05$). It meant that the forecast formula of bend speed developed by Greene in 1985 could be used in present PU track [3] (please refer to Fig. 4), thus we can apply it to substitute the actual measurement.

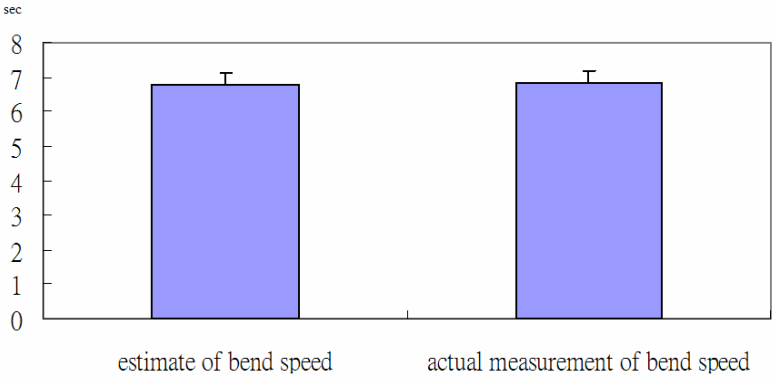

Fig. 4. Comparison between estimate and actual measurement of bend speed

3.2 Comparison between the Grades of Experimental Checkmark and Traditional Checkmark

The grades of experimental checkmark were better than the grades of traditional checkmark ($p < .05$) (please refer to Fig. 5). Therefore, the estimate of computer assistance program for checkmark position by the different bend radius of curvature of different lanes in 4×100 m relay could be applied to the real competitions which can provide the runners and coaches as prompt references, which expect to reduce the possibility of mistakes of baton exchange and let relay process more easily completed.

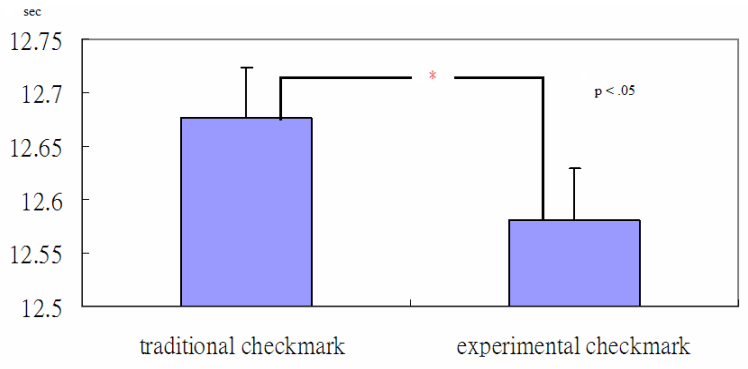

Fig. 5. Comparison between grades of traditional and experimental checkmark

4 Conclusion

The estimate of computer assistance program for checkmark position by the different bend radius of curvature of different lanes in 4×100 m relay could be applied to the real competitions which can provide the runners and coaches as prompt references, which expect to reduce the possibility of mistakes of baton exchange and let relay process more easily completed.

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