

# THE VELOCITY STRUCTURE OF APPROACH AND PERFORMANCE IN THE LONG JUMP

Jia-Ying Zhou and Li-Ze Kang

Department of Physical Education, Xian Physical Education Institute, Xian,  
People's Republic of China

The purpose of this study was to examine the velocity structure of the approach in the long jump event. The effect of approach technique in overall performance will also be assessed, using biomechanical analysis. 527 full run-up horizontal velocity curves of long jump measured in 527 trials using an SCL-II Model Sports Radar Velocity Finder Instrument were analyzed and summarized. From the data, it was concluded that the full run-up of the long jump, measured in horizontal velocity curves could be classified into five types (platform type, gentle descending type, rapid descending type, multi-peak type and tail-rising type). By keeping the velocity change of approach at a stable rate and maintaining high speed in the sprint, the jumper can achieve a good performance. The acceleration style of approach can be divided into two types (rapid rising type and gentle rising type). The change of acceleration velocity value reveals the long jumper's velocity ability and the stability of run-up. The difference in accelerating ability among jumpers at different levels appeared during the first second after the start. Elite long jumpers who run fast after starting often obtain good results.

**KEY WORDS:** approach, velocity structure, performance, long-jump

**INTRODUCTION:** For a long time, researchers have produced many studies of the approach in long jump, and concluded that the effect of the approach to the jump distance is over 70%. Additionally, the peak velocity should be attained within the last five meters or during the last two strides. Based on this research, suggestions have been made for long jump athletes to run at high speed and attain peak velocity before they step on the take-off board.

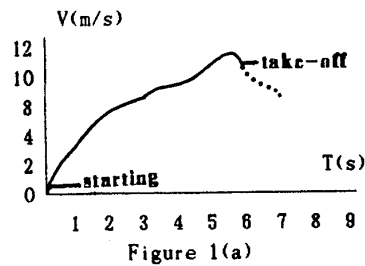
Long jump is an event in which athletes use their innate ability to attain optimum horizontal velocity and to finish take-off at high speed. Technical expertise is required for the optimum combination of horizontal and vertical velocity at take-off. Although the statement "If you want to jump a longer distance, you run fast" has been generally acknowledged, whether it is true has yet to be scientifically determined. From start to take-off, there are many factors affecting run-up. These are the style of acceleration, the time of maintaining high speed, the maximum velocity and the time when it appears, and the characteristic of speed change before take-off. From 1997 to 1998, the horizontal velocity of full approach in long jump has been measured on the scene of competition in order to reveal some problems in approach and to provide information for the athletes and coaches for the sake of improving the overall performance.

**METHODS:** A SCL-II Model Sports Radar Velocity Finder Instrument (developed to measure the horizontal velocity of human movement in sports) was used to measure the horizontal velocity of full approach of long jumpers on the scene of competition. The microcomputer stamps the velocity curve of full approach, instantaneous velocity per tenth of a second and corresponding approach distance. For measuring performance, a SCL-II Model Sports Finder Instrument was placed at the end of run-up path with a distance of 10-15 meters away from the starting point of run-up (behind the jumpers). At the same time, the performance, technique manifestation and corresponding data were recorded by measuring-researcher for each trial. The athlete need not carry any additional material, and he or she is also free from stimulation of light and sound, therefore, the measuring data is valid.

The instrument cannot record jumper's movement period. To determine the take-off point easily in the full approach curve, many synchronization tests have been made using a high-speed camera, a group of electrical switches and a SCL-II Model Sport Radar Velocity Finder Instrument. Through tests, a simple way has been found to determine the take-off point in the curve. If the instantaneous velocity value in the curve drops down steeply and significantly,

this point is take-off point. The error was found to be less than 4%.

From March 1997 to October 1998, long jumpers participating in 10 national or international athletic meets were measured. 572 full run-up horizontal velocity curves (male 421, female 151), and instant velocity value of every 1/10 second and corresponding distance covered during full run-up in each trial were obtained. Figure 1a, b. The distance for male athletes ranges from 6.5m to 8.16m, female athletes from 5.2m to 6.97m.



×××NO. 02×××		
T	V	S
00.1	01.00	00.1
00.2	01.82	00.5
00.3	02.10	00.7
00.4	02.48	00.9
00.5	02.91	01.2
⋮	⋮	⋮

Figure 1(a)

Figure 1(b)

**RESULTS AND DISCUSSION:** According to the change in velocity of full run-up, especially the change pattern from peak point to take-off point, 572 curves of 33 long jumpers were classified into five types. They are platform type (a), gentle descending type (b), rapid descending type (c), multi-peak type (d) and tail-rising type (e). Figure 2 (a, b, c, d, e)

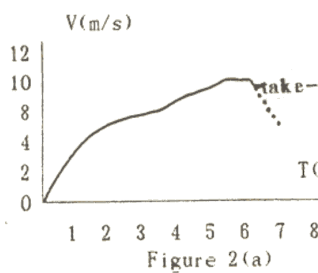


Figure 2(a)

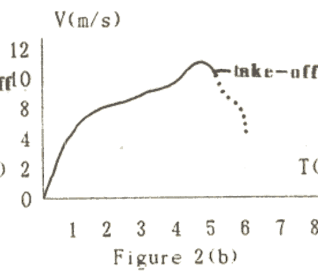


Figure 2(b)

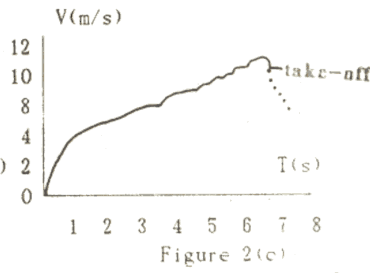


Figure 2(c)

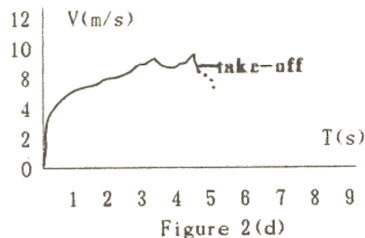


Figure 2(d)

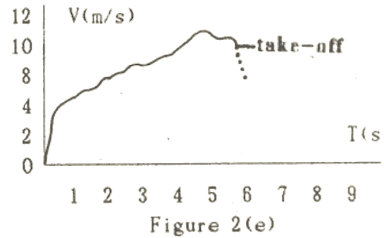


Figure 2(e)

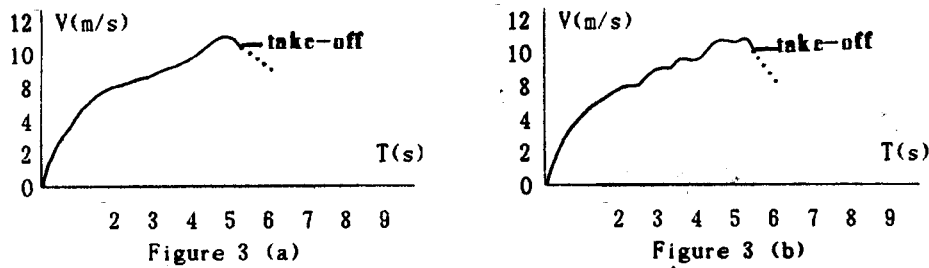
It was determined that many elite male long jumpers' type of velocity is a gentle descending type. The patterns of multi-peak type and tail rising type showed that the long jumpers' approach was often unsuccessful as these two patterns appear only in beginners. Multi-peak type was not found in female athletes, but platform type was found only in elite female athletes.

Through the statistics obtained from 572 curves, it was found the correlation coefficient between peak velocity and the distance jumped was males, (0.8404) and females (0.8280) ( $p < 0.01$ ). The correlation coefficient between the time of maintaining high speed (95% of peak velocity) and the distance jumped was males (0.6977) and females (0.5975) ( $p < 0.01$ ). According to performance levels, participants were divided into four groups (male) or three groups (female). The correlation coefficient was computed and it was found that with the development of performance, the correlation coefficient between peak velocity and the distance jumped becomes gradually smaller, but the correlation coefficient between the time of maintaining high speed and the distance jumped becomes gradually bigger. The above results show that in general, the maximum velocity plays an important role in improving performance. In training, elite jumpers should focus on improving the ability to maintain high

speed. On the other hand, coaches of beginners should emphasize the need to develop speed.

From the appearance of peak velocity to the instance of take-off, the times elapsed for athletes are from 0.51s to 0.53s (male) or from 0.43s to 0.46s (female). The velocity descending ratio ( $V_{max} - \text{instant velocity at attacking board} / V_{max} \times 100\%$ ) respectively is 9.5%(male), 6.4%(female), but experienced jumpers' velocity descending ratio is about 5% (male, above 8.00m) and 3.4%(female, above 6.5m). The above data show that elite female long jumpers' ability of maintaining high speed is better than that of male long jumpers.

Numerous trials indicate that the key of run-up is to keep the change in velocity stable. Elite long jumpers are able to run at high speed, but sometime they do not gain good results because of less stability in velocity in run-up. (see Figure 3a and 3b)

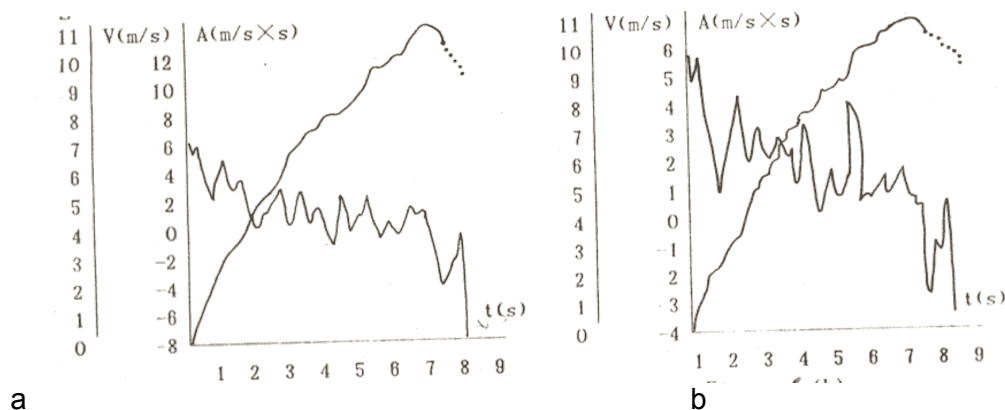


**Figure – 3 The velocity curve of subject 8 with a result (a: 8.16 m and b: 7.46 m)**

It has been established that in run-up, long jumpers must run certain strides in a certain distance. When there is velocity fluctuation, this means that there is change in length of stride and time of stride. This change must be adjusted in the following strides, otherwise, long jumpers cannot take off accurately. Therefore, it is very important for the long jumper to control himself in order to finish run-up smoothly and steadily.

According to the slope of the velocity curve, acceleration styles can be divided into "rapid rising style" and "gentle rising style". (If velocity goes up quickly after starting, the acceleration style belongs to "rapid rising style; otherwise, "gentle rising style"). The acceleration style of most long jumpers belong to "rapid rising style", tall and heavy jumpers mainly have "gentle rising style". From start to the appearance of peak velocity, the time and distance respectively accounts for about 90% (male, 91%) of the full time and 88%(female, 89%) of the full distance. At this point, there is hardly any difference between male and female long jumpers. The difference in acceleration ability among jumpers at different levels appeared during the first second after starting. Elite long jumpers who run fast after starting often obtain good results, but when they run too fast they will fail to take off successfully.

In general, the change of acceleration velocity value reveals the long jumper's velocity ability and the stability of run-up. However, he or she cannot obtain good results if the acceleration velocity changes greatly. For example, (see Figure 5a and 5b).



**Figure 5 (a, b) – The velocity curve of a subject with a result of (a: 7.89 m, b: 7.61 m)**

**CONCLUSION:** Run-up plays an important role in the whole technique of long jump. From observation of the full approach, horizontal velocity curves of long jump, coaches can find the discrepancies in the approach in jumpers and develop methods that will significantly improve the distances attained in the long jump event.

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