Dynamic simulation system in Shot Put

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Introduction:

Shot put is a technically challenging discipline that requires high coordination ability and tremendous speed strength. The ball is placed on the finger roots and the throwing hand held next to the chin to the neck side. The shot put technique involves a series of complex movements within a limited area of a circle which must have a diameter of 2.135m (± 5mm) with a board firmly fixed to the fingers connected to the ground outside the outer limits of the circle. The rules require that the shot must be spherical, and weigh 7260kg for men and 4,000kg for women (IAAF Competition Rules 2012-2013). The pushing phase in the shot put is main acceleration phase of the technical principle to the level to be attained power and release release velocity mit optimum angle **(Bauersfeld & Schröter, 1998)**.

The achieved result of the throw depends on Physical variables, motor abilities, and throwing technique (**Coh, 2005**). In **Linthorne's** opinion (2001) the throwing technique requires great throwing explosive strength and the ability to perform the elements in the precise moment and in limited space. The goal of the athlete is to throw the shot away as far as possible, but according to the rules and regulations of the competition. Rotational (spin) and the Slide (O'Brien) throwing techniques are considered equal, but it was noticed that beginners and female athletes often use the slide technique, while men use the rotational technique of throwing more often (**Young, 2009**). The authors **Coh et al. (2008)** investigated the rotational model of the two techniques of elite shot putters with different anthropometric measures. Differences were found for: release velocity, release height, and the shot. The shot putter has to optimise the angle of release, the release velocity and the height of release so as to achieve the maximum throwing distance. The shot put result (TD) may be physically defined by the following formula on the assumption that air resistance is disregarded. The best combination of throwing speed, angle and height of ejection. The highest correlation exists between the throwing distance and release velocity. That is the most important factor in throwing (**Aleksic et al., 2011**). **Ballreich (1986)** indicates that the throwing distance influenced with many complicated mechanical variable like V0 release velocity of throwing , α0 angle of release, h0 height of release.

Sport has become in all sectors closely linked to the use of technology. The use of the computer with modern instrumentation has now become a medium of instruction in many areas of sports, by which assist in the process of assessment and forecasting directly and objectively. Technological assistance through specific measure units is a firm component of the technique training in high level sports (**Daugs, 2000**). Objective measures and feedback are today indispensable in the training of many sports disciplines. The technological basis necessary is provided by sport-specific measuring and information systems that give objective information to coach and athletes about performance-related parameters of a movement or a condition exercise (**Geese, 1992**).The methodical approach of fast objective feedback information can be justified by the fact that self-information and subjective perceptions of the movements are consciously compared with the objective information from the outside (**Farfel, 1977**). The release velocity of the movement in the release phase causes problems for athletes, coaches and researchers, because feedback on movement performance is hardly available. Usually the athlete receives only feedback in form of throwing range. indoors the necessary area is not always available for appropriate throwing ranges, alternatives for this special purpose must be developed. When the main objective is to achieve more distance, the athlete should be aware of the principles of biomechanics and some important characters such as the angle and velocity of release.

The studies of **Hinz (1991)** and others show that the velocity was more influencing in throwing distance which reached 14m/sec for male. Such information seem to be very difficult to get and evaluate through vision of a movie analysis due to the high speed of movement. Training with measuring and technological devices to objectively additional fast information today is an indispensable training tool in almost all sports. A requisite technical and technological basis are sport specific oriented measurement and information systems. The designation measurement and information systems should be pointed out that it was no longer alone at the fairs, but also about the provision of emergency information for the users (coaches and athletes). **Vitasalo (1987)** used light signal to measure the angle and the velocity of the attack of the javelin throw. This study is similar to **Adamczewsk (1995)** which innovated this mechanical system in the IAT. Those throwing methods are the best methods regarding to measure the velocity and to reach the information in less than 20 sec. but the negative point is the missing accuracy of the throwing velocity measurement. The other devices which were innovated in Halle (Germany) is a training device rather than measuring device, especially when combined with 4-30 kg and not movable.

Procedure: A dynamic simulation system to learning the main acceleration phase in Shot Put technique was developed, which consisted of a 7.260kg sledge to be accelerated along a rope and a LAVEG measure unit. Takeoff angles can be adjusted within the range of 31 - 41 degrees. The takeoff height can be likewise adapted to the individual conditions of the athlete. By a laser-steered measure unit (LAVEG) the speed of the throw carriage can be determined. Due to the high relationship between release velocity and throwing range in Shot Put the release velocity of the simulated Shot Put serves as indicator of the throwing performance. This information can be provided as feedback within 5 to 10 s on a screen.

Basic approach: The basic idea of the simulation, the acceleration of a shot put model is used on an inclined plane. A tube functions as a model of a shot put and is located on an approximately seven-meter-long rope. The rope is between two fixed points at different heights tense inclined plane. The shot put model can slide freely between the two points, so that the shot put this speed with the hand in the direction of the elevated point. So that the athlete will be Given the option of dropping technique of the shot put to exercise control on the model. In addition to simulating the dropping technique should be both rapid and quantitative statement about the speed of the Shot Put model possible in order to meet the demand to use the unit as a rapid information to. The problem of velocity measurement is achieved using a laser measurement device (LAVEG), the distance by measuring the Shot Put model in relation to the laser facility in a position to determine the dropping during simulation, the values for these physical parameters. However, this can be in conjunction with appropriate software . The entire dynamic simulation system in the shot put consists of 3 parts indicated (1)

Including steel rods and litter sled, (2) LAVEG laser velocity device and special software (DAS3 Program) for the electronic evaluation, and (3) hardware (PC or laptop).

Later in the program are DAS3 data on the screen numerically and graphically and presented with various additional information to determine the relationship between speed and distance to time, and speed to time with diagram chart to describe this relationship on the axle Y,X according to which shows the connection of those parts within 10 sec. As a crucial advantage of LAVEG measurement system proves to be an analogue of recorded velocity-distance course. The unit reviewed internally by a mathematical procedure, the extent of the discrepancies. If a certain threshold is exceeded, the measurement can be extended (with a large number of individual measurements) to a maximum of 1 seconds. The accuracy of the LAVEG device is 0.1 ms-1 to 10 ms-1, 0.3 ms 1über 10ms-1 **(Jenoptik, 2002)**.

Scientific Processing (Validity and Reliability) of the dynamic simulation system

Criterion is a special aspect of construct validity. This is when the measurements with another construct valid measurement of the criterion are highly correlated. The correlation coefficient indicates the strength of the relationship between the parameters of departure speed of Shot Put (V0) and the parameters of the initial velocity on dynamic simulation system (r = 0.94). This means test by dynamic simulation system is valid, because it correlates with test V0.

10 sample (Students) completed three test throws the dynamic simulation System. The initial velocity was (after three days) at a repetition of the measurement under the same conditions and at the same objects repeated. There were almost always the same results exist. The calculation of reliability (r = 0.88) showed a high reliability of the analytical method.

Results and discussion: Both groups improved their throwing range between pre and post test. The experimental group (G1) , which completed supplementing training, achieved higher progress for throwing range and release velocities than the control group (G2). The throwing range increased in average of G1 from 6.54m ± 0.71 to 9.73m ± 0.67, Average values of G2 were 6.44 m ± 0.75 (pre test) and 8.46m ± 1.02 (post test). The average release V0 in group G1 increased from 5.13m/s ± 0.28 to 7.52 m/s ± 0.50, whereas in group G2 value changed little (from 5.17m/s ± 0.45 to 6.32m/s ± 0.68). The comparison group is necessary to show the output level of the two groups. In the comparison between the two groups are not all determined parameters are considered. It the values are rather used in which group independently significant effects were achieved. The throw goes mainly to the improvement in the subjects group (G1) more pronounced than in the volunteers group (G2), which is confirmed by the calculated averages of the changes. The average performance on both days of competition as a whole and broken down by category is summarized in.

The actual release angle, where the height of the release and the release velocity are taken into consideration, ranges from 31° to 36° **(Milan, 2008). In Essam's** opinion (2013) the actual release angle ranges from 38° to 41° . This results in the fact that the approach to this angle would have a greater casting distance result. The following tests may now this approach but not show and it would thus come to a distorted result.

Clearly this would be if one group 1 is considered . In terms of the parameter ($\alpha0$) it is noted that the average values of the parameters ($\alpha0$) in group (G1) before and after the test of 48.57° to 43.14° only insignificantly have and for group G2 greatly changed from 45.42° to 48.28 °. So you would not receive any significant values for G1 with G2 (T=-1.82, p= 0.108), although this group has thrown at an optimum angle and the throw was correspondingly higher than in G2. However, as a strong level of significance would be reached again in the post-test , although this can not be more closely related to the throw , because the deviation from the optimum launch angle is enormous. Determined variable H0 increases in the group of subjects (G1) from an average of 177.85 cm (± 8.87) to 206.00 cm (± 11.95), compared with a rise of 177.84 cm (± 11.45) to 177.00 cm (± 15.56) in the group of subjects (G2). The t-test applied to subjects group (G1) pre / post-test, a significant result (T = 5.00, p= 0.001), in contrast to the group of subjects (G2) in the pre / post test, where the results of the t-value are not significant (T = -0.11, p= 3.90). Possible reasons for the difference may be Better feedback (angle control, velocity measurement) „The clearer and comprehensive information is the self that can visualize the athletes, to put them with the coming of external feedback in relationship, the more effective are the supplementary information **(Grosser, 1982).**“, Motivation (attitude of the athlete for learning and training) and Additional training by dynamic simulation system.

In Research of **Tünnemann (1995)** and could be found that the measuring station training is very important for the learning effects in dealing with special testing procedures, but it is just as significant in terms of educational background and so associated increase motivation and technique training and awareness of the athletes. As the results of the investigation by **Motta (2001)** show, can contribute to the physical variables feedback to the improvement and increase in the level of technical training. For the future some prognoses can be derived in the reference of the development and the employment of fast feedback systems. In the course of the last decade particularly substantial technological progress can be registered, which results in more efficient, smaller and more mobile measuring devices. In the context of this development an outlook on technical innovations usable for feedback training in high level sports is inevitable. Therefore, multi-functional measure systems, which are applicable for the analysis of performance in different sports disciplines, will gain importance and attractiveness. Likewise, the material as well as the financial expenditure in the future should be able to be reduced, which will entail a more comprehensive application of the measure systems for the analysis and training in sports.