

SKILL ANALYSIS THROUGH COMPUTER GRAPHIC FEEDBACK

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Many experienced coaches can easily identify the athlete's performance errors and that athlete can try to correct the fault following the coach's direction; however, sometimes the athlete misunderstands the direction or does not fully understand what he/she should correct in the skill. At that point a high speed camera or a video camera may be used to facilitate the motion analysis. Although this allows the athlete to receive feedback about the performance, it does not allow a comparison of the performance with an ideal performance of another athlete without dependence upon the athlete's ability to memorize and recall the correct skill execution.

Several researchers used computer graphics in their literature to describe or simulate human motion with just stick figure or a three-dimensional figure (Boysen, Francis, & Thomas, 1977; Dapena, 1981; Miller, 1971; Riley & Garrett, 1976; VanGheluwe, 1981). Research that analyzes human performance using displayed graphic figures was not found.

The purpose of this study was to overcome the limitation of cameras by visualizing digitized data from film of human motion. For this purpose a computer program was written to represent the two-dimensional digitized coordinates in a three-dimensional figure display applying computer graphics. To demonstrate this procedure running, a soccer kick, two methods of soccer throw-in were selected. Visualization of the human movement pattern may then be used to provide researchers and coaches with a means of analyzing and evaluating that movement.

GRAPHIC MODELING

A three-dimensional computer model (Figure 1.) was developed consisting of 14 rigid segments with cylinders, an ellipse for the head, and cones for feet to represent the human body. The right side of the body is shown using a line drawing and the left side is represented by a dotted line to distinguish the two actions.

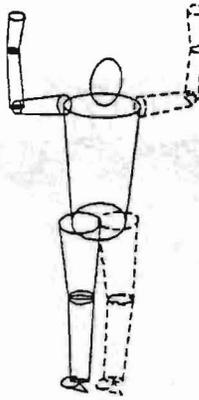


Figure 1. Graphic Model of Human Body

METHOD

Films of running, soccer kicking, and two soccer throw-in (without an approach and with an approach) were obtained using a 16-mm Photo Sonic IPL high speed camera. A 16-mm Lafayette Motion Analyzer was used to project the films and joint centers were digitized using a Numonics Electronic Digitizer to record on a tape of a Hewlett Packard Graphic Terminal (Model No. 2647A).

Two sets of data, however, are required to run this computer program. One is the anthropometric data obtained from the film by digitizing 28 points from which the width and length of each segment are determined. Using these anthropometric data, variation in segment length can be displayed visually in three-dimensional space. The other is the digitized data from each frame of the subject's performance. The recorded data were then transferred to a Cyber 172 computer from which it was sent to the Textronix 4014-1 computer display terminal to display the three-dimensional figures by using the Textronix Plot 10 Graphic subroutine (PLOT10) and a Textronix 4611 hard copy machine was used to obtain the graphic output.

APPLICATION

Several options are provided by this computer program. The user may obtain a drawing of the total body for every frame. Figure 2, display the running for every frame but the each figure is drawn so densely that it is hard to recognize the motion. By this reason, the user may choose to review every third or fourth frame (Figure 3.) or apply the transformation of the

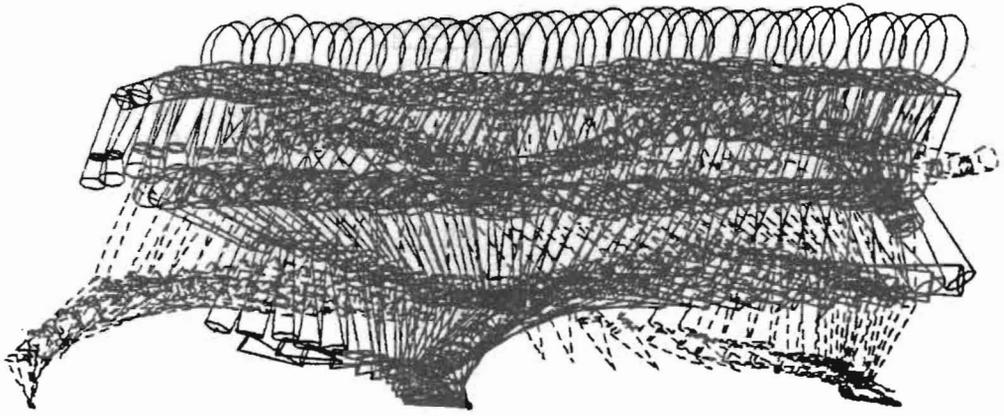


Figure 2. Computer Display of Running Viewed Every Frame.

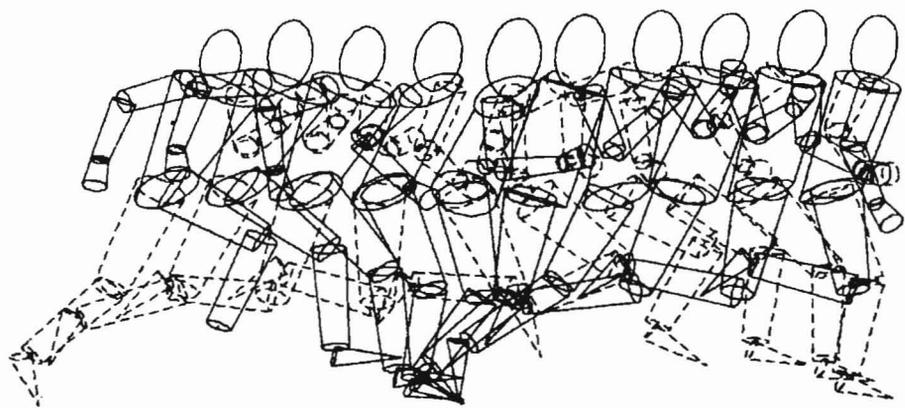


Figure 3. Computer Display of Running Viewed Every Fourth Frame.

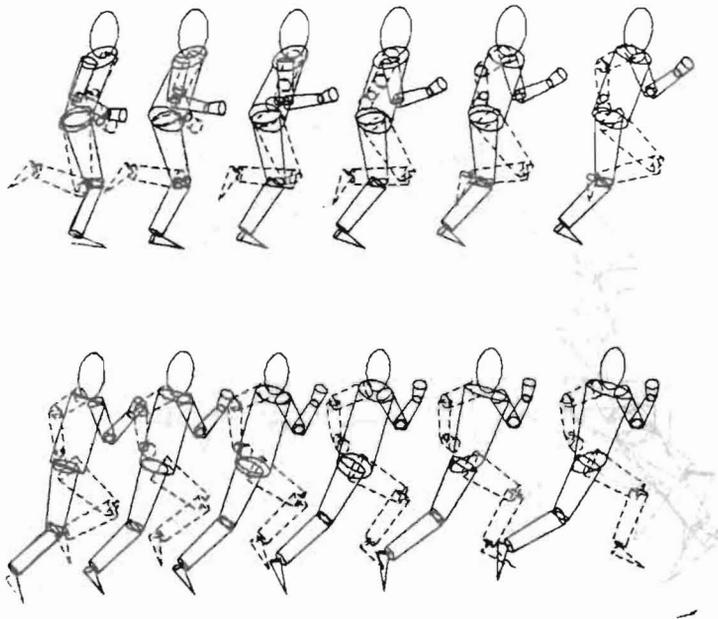


Figure 4. Computer Display of Running Applied the Transformation of the Coordinates.

coordinates to alter the distance between frames and/or change the image size of the figure (Figure 4.). In a specific skill the most important body segments, up to five (program can be altered for more.), may be isolated by the user, e.g., lower arm and hand, leg and foot, trunk and head, etc. (Figure 5.). Figure 6 and 7. represent a comparison of two methods of executing a skill. The display provides important temporal and displacement information to permit a contrast of a soccer throw-in with and without an approach when distance is needed. A single frame which is worthy of notice could also be selected to make a comparison of skills (Figure 8., Figure 9., Figure 10., & Figure 11.).

CONCLUSION

As a result the computer graphics generated by this program can

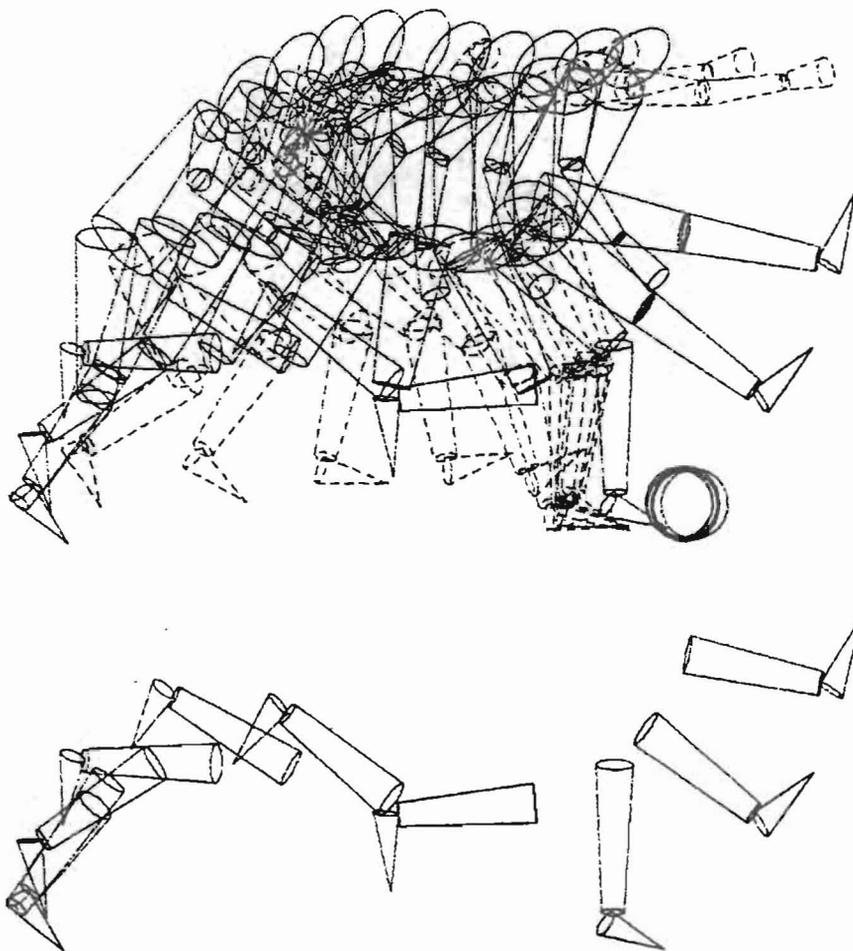


Figure 5. Computer Display of the Soccer Kick for the Total Body, Right Foot and Right Lower Leg.

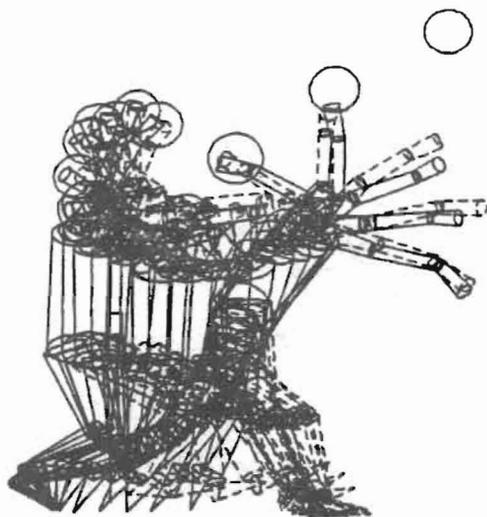


Figure 6. Computer Display of the Soccer Throw-in without an Approach.

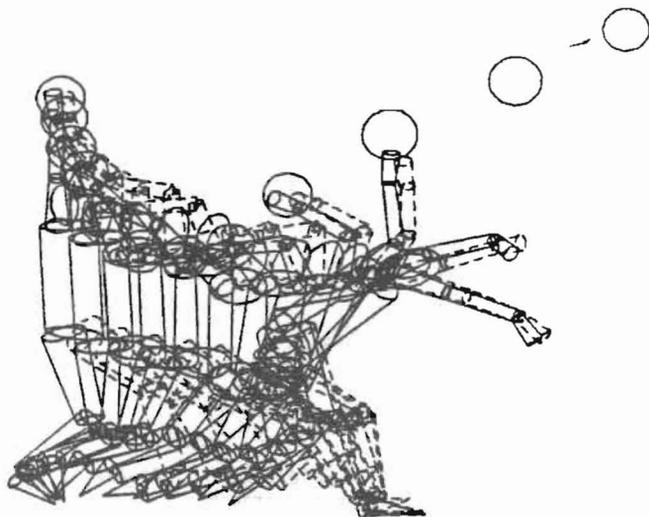


Figure 7. Computer Display of the Soccer Throw-in with an Approach.

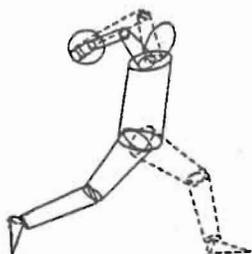


Figure 8. The Moment of Wind-up without Approach.

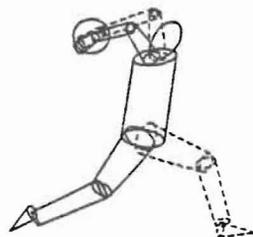


Figure 9. The Moment of Wind-up with Approach.

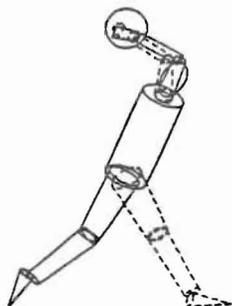


Figure 10. The Moment of Releasing the Ball without Approach.

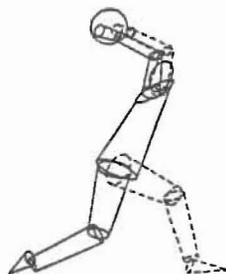


Figure 11. The Moment of Releasing the Ball with Approach.

be used to demonstrate and teach skills to both the skilled and unskilled player and to display individual performance to facilitate error correction.

ACKNOWLEDGEMENTS

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