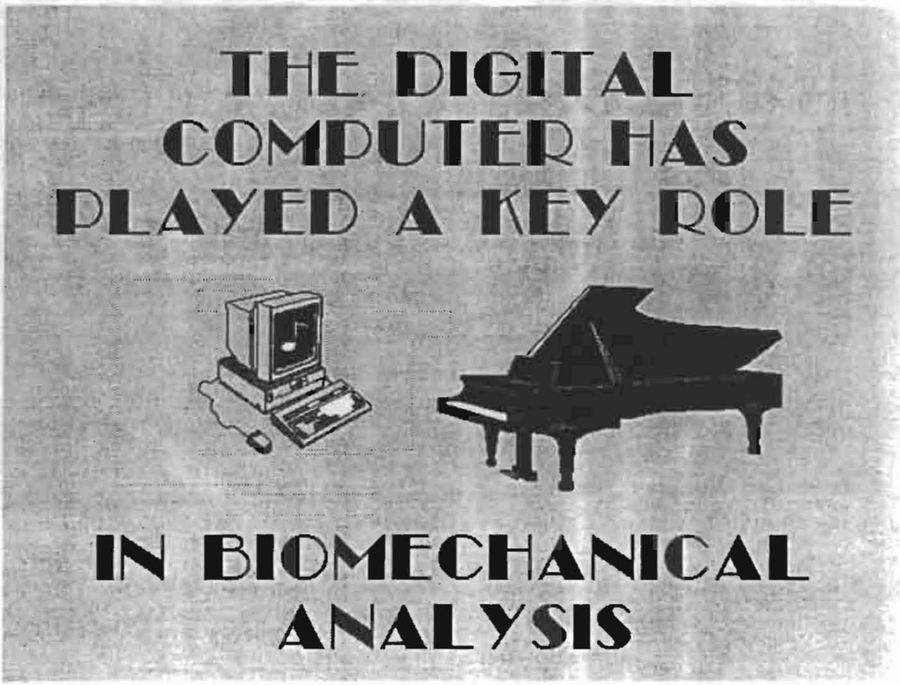
Doris I. Miller

Faculty of Kinesiology
University of Western Ontario
London, Ontario, Canada

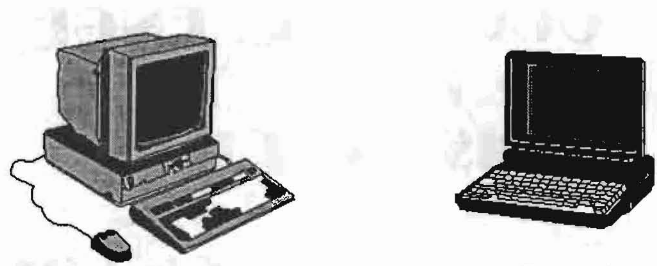
It gives me a great deal of pleasure to participate in the opening session of this ISBS conference. I recall a similar experience about 10 years ago when the conference was held in San Diego. On that occasion, I had chosen a similar topic dealing with the issue of information interchange between sport biomechanics researchers and coaches. As is evident from the title of my presentation for this conference, I am still concerned with that general issue. At this point in time, however, with the improvements in technology over the intervening period, I believe it is appropriate for us to consider accepting the challenge of communicating with coaches by computer.



I do not think anyone would deny the essential role which the digital computer has played in biomechanics research and analysis. Using the computer for research purposes is not new although it is certainly easier than was the case several years ago. And the fact that we provide coaches with results of the computer analysis of our data is also not new. We have been doing that almost since the time we began to employ computers on a regular basis in our research. But what I am going to suggest that I believe is new, or at least more feasible than it has been in the past, is actually putting the process of computer analysis in the hands of the coaches.

OUR CHALLENGE IS TO PUT ANALYSIS PACKAGES IN THE HANDS OF THE COACHES

Putting analysis packages into the hands of coaches should give them more control over the focus and direction of the analysis, make them more responsible for the application of specific findings to the performance of their athletes and provide them with an avenue for increasing their understanding of basic principles of biomechanics by making direct application to their sport. These analysis packages would consist of three components. The first would include computer analysis programs presented in such a way that they could be readily accessed by coaches and athletes. The second would be a current data base to enable coaches to see differences in performance exhibited by athletes of varying levels of skill including international competitors. And the third component would consist of instructional modules to assist coaches in using and interpreting the results of the computer analysis. In the development of these computerized biomechanical analysis packages, we must take into account the existing state of the microcomputer hardware and software as well as the background and expertise of the potential users.

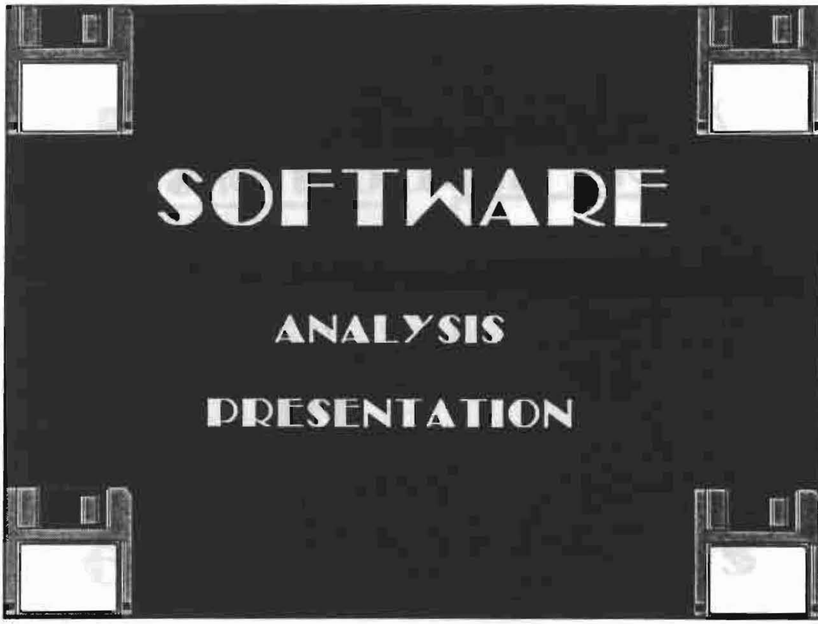


Today's Microcomputers

Smaller Lighter Cheaper
Faster Larger Capacity
More POWERFUL
In Widespread Use

If we are going to communicate with coaches by computer, it goes without saying that they must have access to these machines. Thus, it is important to note that microcomputers are in widespread use by members of the general public. Many coaches now have microcomputers in their homes, clubs or work situations. In addition, most athletes and younger coaches are computer literate as a result of their exposure to computers in the educational system. While some established coaches are still showing resistance, others are eager and willing to learn how they can utilize this modern technology in their sport.

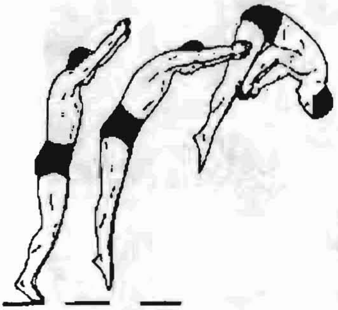
In terms of existing microcomputer hardware suitable for use by coaches, the field narrows to two major options: Apple Macintosh and MS-DOS (i.e. IBM-Compatible machines). We chose the latter because it was required by our Peak 2D video digitizing system. In the near future, it should be feasible to develop and run computerized biomechanical instructional packages interchangeably on either type of microcomputer.

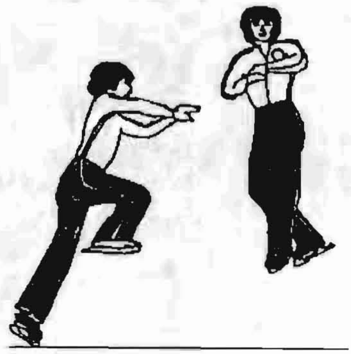


With respect to software, consideration must be given both to data analysis and to the presentation of concepts. If we are going to distribute analysis programs and instructional modules to coaches, it is important that these programs not be tied to proprietary software and/or hardware. For the most part, this means writing our own software for specific applications and/or using commercial packages which allow output to be distributed without additional cost.

Our recommendation of a programming language for data analysis is QuickBASIC. For microcomputers, it is the practical replacement of FORTRAN which was used extensively on mainframes. QuickBASIC, which is both powerful and user-friendly, is now being provided with DOS 6.0. One of its major advantages is its portability. Virtually anyone with some programming background can follow QuickBASIC code, especially if it is adequately documented. Thus, the program code can be readily accessed by graduate students and personnel in sport governing bodies who may want to make custom adjustments to the analysis or display of results.

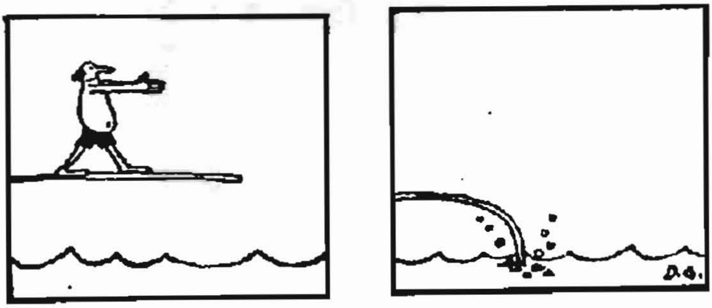
SAMPLE APPLICATIONS





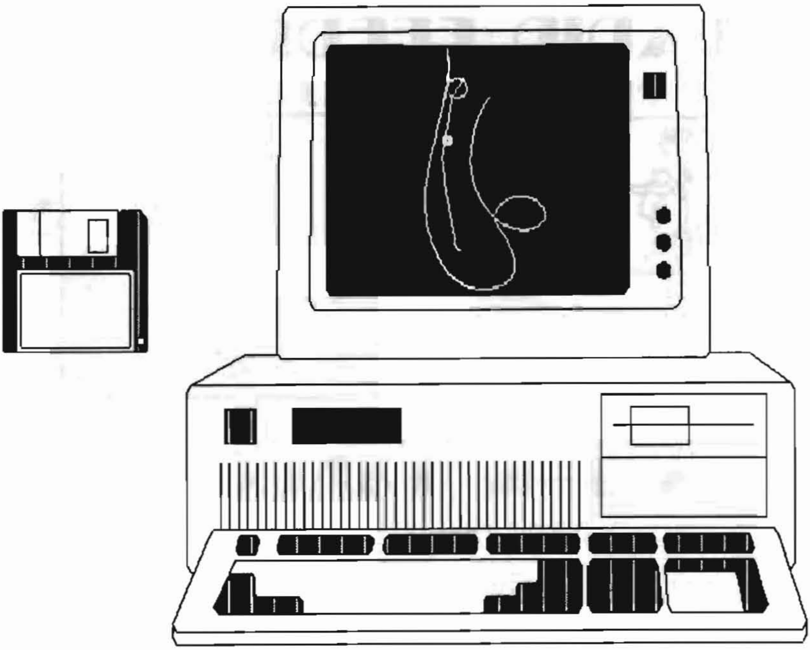
Although we do not claim to have had a great deal experience with many of the increasing number of other presentation software packages, we are pleased with IBM's Storyboard Live! in preparing instructional modules to accompany our diving and figure skating analysis programs. Storyboard Live! allows the use of text, clip art, animation, sound effects and a variety of fades linking one 'slide' to the next. Illustrations of a specific nature can be scanned, brought into the program and edited to convey the desired information. Line art works best for this purpose as it does not require as much computer memory as do images involving excessive shading or color. Storyboard Live!, when used in conjunction with an active matrix video projection panel, provides the basis for an effective presentation for large groups. The illustrations in this paper are hard copies of some of the 'slides' made with this package. Storyboard Live! also works well in situations in which coaches will be viewing material on their own micros. Approximately 30 'slides' of information will fit on one 3.5 inch high density diskette. 'Stories' created with this software, along with the execution file to run them, can be distributed for noncommercial purposes providing an acknowledgment of Storyboard Live! is given.

RAPID FEEDBACK

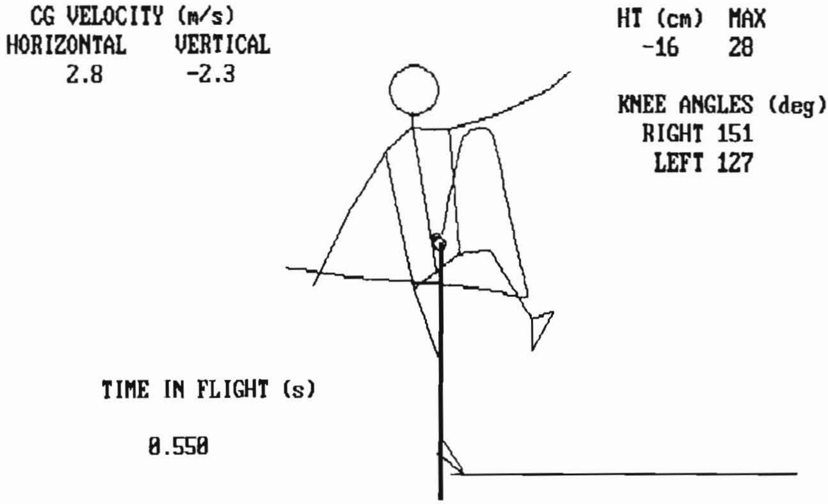


ON 3–m TAKEOFFS

As part of a project supported by Sport Canada, we have developed analysis programs, accumulated a reasonably extensive data base and prepared instructional modules which can be used by competitive diving coaches. When the project began in 1988, we were concerned with providing coaches with rapid and meaningful feedback on the 3-m take-off mechanics of their own divers. Two national or international competitions were videotaped in each year of the cycle leading up to the 1992 Olympics. Performances of the top 10 men and top 10 women were digitized and the results distributed to the coaches within a period of three weeks after the competition. Initially, the report in a 3-ring format included stick figure sequences, individual and group statistics and selected graphs. It was evident that, with this medium, only a small percentage of the information available from the computer analysis could be provided to the coaches. Further, because the content of the report had to be selective, it may not have addressed the specific concerns of a given coach. As a result, we have replaced the hard copy report with videoprint sequences of the take-offs and made available two analysis programs to the coaches.



The first program allows the coach to view stick figure sequences of three different dive take-offs simultaneously. Trajectories of the center of gravity or selected body segment endpoints can be superimposed on these stick figures. The second program permits a detailed comparison of two take-offs including linear and angular position, velocity and acceleration. Stick figure sequences are plotted above the color-coded graphs to help put the information into the perspective of the performance. A computerized instructional module has been developed to accompany these analysis programs to familiarize coaches with their operation and potential. The Picture Taker feature in Storyboard Live!, which allows the user to capture the contents of a monitor display such as a graph from an analysis program, was particularly useful in this regard. Additional modules on specific mechanical principles applied to diving are currently being developed .



A second Sport Canada project in which we are currently engaged is the assessment of axel jumps in figure skating using a four-camera DLT data collection protocol. The three-dimensional coordinates are used to define the skater's sequential positions throughout the course of the jump. The stick figures were developed from a QuickBASIC translation of the MAINJMP FORTRAN program written by Dr. Jesus Dapena (Department of Kinesiology, Indiana University). Included on the screen with the stick figure of the skater is information on knee angles, horizontal and vertical velocities and line of gravity. As the project progresses, we will continue to interact with figure skating coaches to get input as to the type of information which would be most valuable to them in assessing jumping performance.

Just as no computer program is ever final, so computerized analysis packages will continue to evolve. Putting analysis programs in the hands of coaches will place an increasing educational responsibility on biomechanics researchers not only in terms of running the programs but also with respect to understanding the mechanics of the motion and interpreting the output. Instructional modules designed to accompany analysis programs would seem a logical way to proceed. At this point in time, the technology is both available and affordable. Many coaches are in a state of readiness to capitalize on microcomputer capabilities related to their sports. It is therefore incumbent upon sport biomechanics researchers to accept the challenge by developing appropriate software for analysis and instruction.