



How could a computer enhance your performance?

The APAS system at Data General



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The article discusses the international coverage and follow-up plans for G. Ariel. Various dailies in England, Sweden, France, and Italy have reported on G. Ariel, with additional articles appearing in trade, electronic, sport, and medical press. Future plans include a national meeting in England with the Great Britain Olympic Committee, a live demonstration and interview in Germany, and a feature article in Italy's "Science and Life". In France, a meeting with the National Institute for Sport is being arranged.

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Below find a reprint of the 13 relevant pages of the article "How could a computer enhance your performance?" in "Data General":

How could a computer enhance your performance?



are helping make human motion . . . safer and more productive. And revolutionizing Olympic training in the process.

The Student/Teacher Syndrome

When University of Massachusetts' student Gideon Ariel first proposed combining high-speed cinematography with the biomechanics of human motion in order to improve sports performance, his professor wrote on the paper, "Gideon Ariel is a dreamer."

Within two years the professor was working for Dr. Gideon Ariel. Now, less than a decade later, the entire U.S. Olympic leadership shares the dreams of the former Israeli Olympian. In fact many people in and out of the Olympic movement believe the imaginative computer scientist is about to revolutionize sports.

The Company: A Scientific Analyzer of Man and Motion

Computerized Biomechanical Analysis, Inc. is the world's first research company created specifically to scientifically analyze and evaluate the dynamics of human motion. Founded early in 1971, CBA initiated its work in the area of improving athletic performance. By mid-1974, CBA was also involved in the development and improvement of sports equipment and industrial products, as well as, in research supporting governmental agencies concerned with industrial and consumer safety.

Biomechanical Analysis, Dr. Gideon Ariel's chief business is testing and designing athletic equipment to maximize effective force. But since 1972, he has also been photographing athletes and feeding this visual data into a computer, which turns out a graphic report in terms of force, direction of force, acceleration and velocity of body parts. The computer readouts give a quantitative measure of motion. From these, CBA determines what is necessary to perfect an athletic performance, when the only limitations are the limitations of muscles and ligament. Using data from medical science, they know at what point the forces exerted begin to tear human tissue. CBA's methods fall in the realm of biomechanics.

"Biomechanics is the future not only for the Olympic movement, not only for athletes, but for studying the human movement as it relates to physics," says Doug Dunlap, the U.S. Olympic Committee's director of planning. "And Gideon Ariel is the only person who understands the total implications at this time."

Gideon has also been the recipient of a glowing testimonial from Dr. Irving Dardik, the head of the U.S. Olympic Committee's medical staff. "The work he has done is fantastic," said Dr. Dardik, a Nobel candidate in medicine. "He will make a revolutionary contribution in the practical application of computerization techniques as it relates to all Olympic sports. Already he has had dramatic results."

training program - some say the most important segment - has been turned over to this method. Professional teams have enlisted it to cure injuries and improve free-throw shooting. Industry has asked CBA to design shoes and weight equipment.

The greatest testimonials come from athletes themselves.

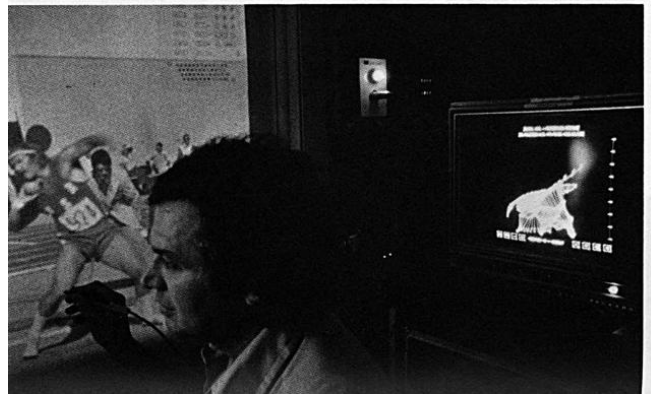
Improving On "Perfection"

In 1976, for example, CBA studied Mac Wilkins, the discus thrower. "Based on calculations I made," says the biomechanical engineer, "I could see Wilkins dissipated too much muscular force overcoming the friction between his shoe and the ground. I told him to pour water on the ground where his foot rested. He threw about two hundred thirty feet immediately. Until then, his best was two hundred fourteen feet. The water reduced the friction drag. A different shoe, one that lowered rotational friction, would have brought the same results."

The best that Wilkins had thrown in 1975 was 219 feet, 1 inch. The world record was 226 feet, 8 inches. Ariel told Wilkins that, according to the computer, he should be able to throw as much as 250 feet. The second time Wilkins put Ariel's advice to work, he broke the world's record. At the Montreal Games, he threw 232 feet, 6 inches to win a Gold Medal.

Computer-Oriented Comments on Sports

Some skeptics believe that Ariel is not really saying anything that coaches do not already know. Gideon has an answer.



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The best that Wilkins had thrown in 1975 was 219 feet, 1 inch. The world record was 226 feet, 8 inches. Ariel told Wilkins that, according to the computer, he should be able to throw as much as 290 feet. The second time Wilkins put Ariel's advice to work, he broke the world's record. At the Montreal Games, he threw 232 feet, 6 inches to win a Gold Medal.

Computer-Oriented Comments on Sports

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human movement, Ariel says. "Exterior movements happen too fast to follow. How can the eye tell if the shoulder is turned a degree too far to the left? A coach can maybe guess right, but that is all." That's the way Ariel sums up the biomechanical contribution to sports. And based on his analysis, he has reached many conclusions concerning sports.

On golf: "People think what makes a good swing is the follow-through. That means nothing. It's the energy released before the club hits the ball. The follow-through is only the energy left in the club."

On tennis: "The follow-through there, too, is a waste. When Bjorn Borg turns his racket over, it is only for show. The ball is long gone. The ball is on the racquet only four milliseconds. The difference between a good backhand and a bad one is three degrees. Racquets of the future will be wooden. Who says you need strings? The wood will be angled so if you miss in that three degrees, you will still have a chance."

On Kayaking: "In the United States, the athletes accelerate at the beginning of the stroke. They should accelerate at the end like the Europeans. It keeps the tip of the bow down in the water."

On jogging shoes: "Too much shock. People will wear inflatable shoes soon, they will run on air mattresses."

On crew: "In the future, people will row at different times. The first two together, then the next two and so on. It will be like pistons in a car, constantly moving. Much more efficient."

"My ideas make sense," Ariel says. "It does not matter that I know nothing about golf. The physical laws are the same. Gravity is gravity. A hip is a hip. The computer eliminates errors."

Less Pioneer Than Doer

Gideon Ariel does not claim to be a true pioneer in biomechanical analysis, however. For Sweden's Ingvar Fredricson has been studying the motion patterns of standardbred horses with a computer for 10 years, predicting lameness from minute stride irregularities, and discovering that most trotting tracks are banked too much on the straightways and too little on the turns, placing dangerous stress on delicate forelegs. At Penn State, Peter Cavanagh is well along in a study of human stride patterns. But as Ed Burke, the U.S. record holder in the hammer throw and a close friend of Ariel's says, "A lot of biomechanical people are contributing in their own quiet way. Gideon is contributing in his own, uh, inimitable way."

Gideon Ariel's own psychology is nearly as fascinating as his science. A shy athletic boy, he grew up in a boarding school near Natanya,

Although poor in sports, he nonetheless longed to be an athlete. And when in 1956, at 17, he discovered that the best Israeli discus performer had thrown less than 160 feet, he declared "I can do better than that." And embarked upon four years of training, almost demented in its intensity. Speaking to a class at Amherst, he has said, "If you want to be a discus thrower, you have to live the discus. Carry it with you. Sleep with it."

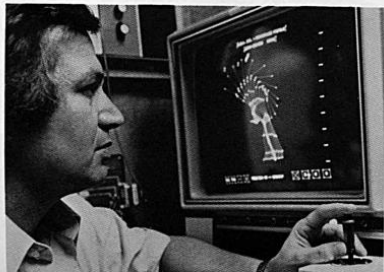
Although never a medalist, Ariel proved himself a worthy competitor... and has done so since in each endeavor he has undertaken. Years later, when Ariel applied to the newly created school of Exercise Science at the University of Massachusetts, he got his master's degree in just nine months.

The Problem: Avoiding Software Obsolescence

It has taken Ariel almost 10 years to complete the programming and development of his company. He started back in 1968, renting time on Dartmouth's computer... programming tons of raw information on athletic performance into the computer through a device known as a "digitizer," a screen lined on two sides by 20,000 tiny directional microphones. The coordinates of any point on the screen touched with a sonic pen are registered and fed into the computer.

The computer then analyzed the athlete's movements, step by step, and produced a thick printout that in essence compared how the athlete performed the maneuver with the theoretically "perfect" way to perform the maneuver - demonstrating exactly how, and where, the athlete should modify and improve his technique.

That was the start.



In 1971 Ariel founded C.B.A. and landed a few contracts testing basketballs for Spalding and shoes for Uniroyl. This allowed him to purchase his own equipment. He selected a Data General NOVA 3/D computer because of its ease of programming and upward compatibility.

Dr. Ariel estimates that it took some 10,000 hours over seven years to create the programs that now instruct his computers. He wants to maintain, utilize and build upon that base. Data General computers make that possible.

A Bright Future

Today, Computerized Biomechanical Analysis has a staff of 12, six full-time. In the back room of its unassuming headquarters is more than \$300,000 worth of equipment, soon to be augmented by Data General's latest NOVA offering, the extended-memory NOVA 4/X system.

Today, C.B.A. is a busy operation. And from a look at some of the services currently being offered by C.B.A. Inc. - computerized health systems for weight control, the study of degenerative locomotor patterns in muscular dystrophy, research and design of children's toys for prevention of injury, analysis of human performance in industry - Ariel and his associates are going to be ever busier in the future.

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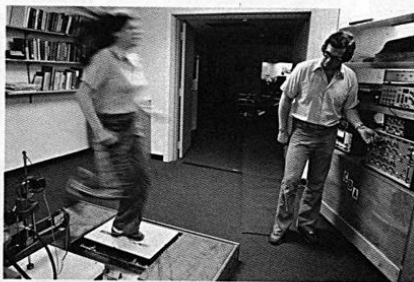
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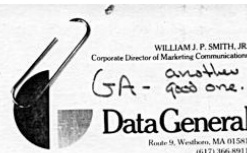
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Data General



How Data General Computers Are Helping Our Athletes Level Mount Olympus



Competition Computers Champions!

The Objective: Help The Best Do Better

"This will be a great tool for our Olympic coaches and athletes," noted Dr. Irving Dardik, chairman of the Sports Medicine Committee, who is in charge of the Bio-Mechanics Laboratory.

There is no such thing as the perfect athlete. Dr. Dardik said, "but the computer will help our athletes get much closer to their full potential."

Dr. Gideon Ariel, a member of the Sports Medicine Committee and developer of the programming that allows the computer to analyze and improve athletic performance, will direct the effort.

The USOC, Mining New Fields... For Gold

Data General's contribution is part of a great increase in corporate support for the U.S. Olympic Committee (USOC).

For the 1980 games, the Committee expects about 50 sponsoring companies compared with 35 for the Montreal Olympics in 1976. And corporate cash donations are expected to rise to \$9 million from the \$4 million last time.

Such largesse has helped the Olympic Committee reach its budgetary requirements for the 1980 quadri-period, \$26 million... double that of the previous Olympiad.

The U.S. Olympic Committee's preparations for the 1980 Olympic Games in Lake Placid and Moscow are well underway. The Committee's first year-round training centers at Squaw Valley and Colorado Springs have already trained thousands of athletes in both winter and summer sports. New programs have been established, including the Sports Medicine Committee, which held the first-ever Sports Medicine Conference at Squaw Valley, and a job opportunities program that has received enthusiastic support of both athletes and the American business community.

The U.S. Olympic Committee's first National Sports Festival, held at Colorado Springs for more than 2,000 of our most gifted amateur athletes, is now an annual event in non-Olympic years.

But of all the new programs and contributions, few have stirred up the interest, that Data General's contribution of a computer has caused.

And for good reason.

"Biomechanics is the future not only for the Olympic movement, not only for athletes, but for studying the human movement as it relates to physics," says Doug Dunlop, the U.S. Olympic Committee's director of planning.

CBA: A Scientific Analyzer of Man and Motion

Computerized Biomechanical Analysis CBA Inc. is the world's first research company created specifically to scientifically analyze and evaluate the dynamics of improving athletic performance. Founded early in 1971, CBA initiated its work in the area of improving athletic performance. By mid-1974, CBA was also involved in the development and improvement of sports equipment and industrial products, as well as, in research supporting governmental agencies concerned with industrial and consumer safety.

As director of research, Dr. Gideon Ariel's chief business is testing and designing athletic equipment to maximize effective force. But since 1972, he has also been photographing athletes and feeding this visual data into a Nova computer, which produces a graphic report in terms of force, direction of force, and acceleration and velocity of body parts. The computer readouts give a quantitative measure of motion. From these, CBA determines what is necessary to perfect an athletic performance, the only limitations being those of muscles and ligaments. Using data from medical science, CBA knows at what point the forces exerted begin to tear human tissue.

CBA's methods fall in the realm of biomechanics. CBA does not claim to be true pioneers in biomechanical analysis, however. Sweden's Ingvar Fredricson has been studying the motion patterns of standard-bred horses with a computer for 10 years, predicting lameness from minute stride irregularities, and discovering that most trotting tracks are banked too much on the straightways and too little on the turns, placing dangerous stress on delicate forelegs. At Penn State, Peter Cavanagh is well along in a study of human stride patterns.

The Problem: The Eye Cannot See...

"The human eye cannot quantify human movement," says CBA Research Director Gideon Ariel. "Exterior movements happen too fast to follow. How can the eye tell if an athlete has turned his shoulder a degree too far to the left or stepped a centimeter short when releasing the ball? In fact, it can't. A coach can maybe guess right, but that is all." According to Ariel, the answers are to be found only in the laws of Newtonian physics.

CBA's system is based on Newtonian physics. "Every type of movement or stress, whether it be human or mechanical, is based on these laws, which are hundreds of years old. What we have done is add modern computer technology."

Gideon Ariel likes to compare training an athlete with the building of a bridge.

"No engineer would construct a bridge without calculating all the stresses and forces involved. Coaches should essentially do the same thing in the training of their athletes. The human eye cannot tell whether an athlete is reaching his fullest potential. For, when competing, athletes generate tremendous forces. These can only be calculated by computers."

The Megatek system automatically registers the coordinates of any point touched by the tracing pen.

At the same time the tracings appear on the screen, information from them is being collected by the Data General ECLIPSE S/250 computer.

The computer then calculates the velocity, acceleration, direction, angle and forces generated by the body's segments.

A computer readout is then provided which outlines the athlete's strengths, weaknesses and possible ways he or she might improve.

The Athlete's Advantage: Predicting Performance Beforehand

The computer can gauge exactly how moving just a bit faster or turning more to the left or right might affect an athlete's performance.

This is a game Dr. Ariel likes to call, "what if" and it lets coaches calculate the impact of these changes on the computer without the athlete actually having to make the adjustments.

"That way we know beforehand whether a change would help or not," says Ariel. "This makes it much easier for a coach to suggest something new to the athlete since he already knows it will work."

The System's Advantage: Avoiding Software Obsolescence

It has taken almost 10 years to complete CBA's programming and development.

Dr. Ariel estimates that it took some 10,000 hours over 7 years to create the programs that now instruct the computers. He wants to maintain, utilize and build upon that base. Data General computers make that possible.

When Computerized Biomechanical Analysis, Inc. was founded in 1971, it soon had contracts from two major sports manufacturers to test their equipment: basketballs for Spalding and shoes for Uniroyal. This allowed CBA to purchase its own equipment. They selected a Data General NOVA computer because of its ease of programming and upward compatibility.

Today, Computerized Biomechanical Analysis has a staff of 12, six full-time. In the back room of its unassuming headquarters is more than \$300,000 worth of equipment, soon to be augmented by Data General's latest NOVA offering, the extended-memory NOVA 4/X system. As well as, Data General's newest and most powerful microNOVA™ computer, the MP/200, which is being incorporated in a computer-oriented exercise machine, that may cause a revolution of its own.

All of the programs developed by CBA on the NOVA 3/D can be run on their new NOVA 4/X system.

A Bright Future

CBA is already a busy operation. And from a look at some of the action underway at CBA - computerized health system for weight control, the study of degenerative locomotor patterns in muscular dystrophy, research and design of children's toys for prevention of injury, analysis of human performance in industry - Dr. Ariel and his associates are going to be even busier in the future.

Regarding the marriage of technology and sports Gideon feels that the true benefits will be seen with the 1984 Olympics.

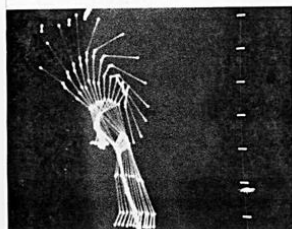
This despite the fact that U.S. athletes won an unprecedented 351 Gold, Silver and Bronze Medals in the 1975 Pan American and 1976 Olympic Games.

To help bring this about he says specialized training schools should be developed for youngsters who have athletic potential.

"Until 1964 talent alone was good enough to win," he concludes. "Since then, however, sports has become a science, not an art." Col. Miller adds, "we always have had the greatest technology in the world in the United States. Now we shall use it."



Analizing - At the same time the tracings appear on the screen, information from them is being collected by a Data General ECLIPSE S/250 computer. The computer then calculates the velocity, acceleration, direction, angle and forces generated by the body's segments.



Digitizing - After high-speed movies are taken of Jeter's every move, Dr. Gordon Krol breaks down the film to show the body in segments. The Megatek system automatically registers the coordinates of any point touched by the tracing pen.



Discussing - A computer readout is provided which outlines the athlete's strengths, weaknesses and possible ways to improve. The computer can gauge exactly how moving just a bit faster or turning more to the left or right might affect performance.



Performing - Al Oerter was an Olympic Discus' Gold Medalist in 1956, 1960, 1964 and 1968. Retired, until recently, Al is now attempting a computer-aided comeback at age 43. His current throws are the longest in his career.

DataGeneral
Rout 3, Woburn, Massachusetts 02190
Telephone: (617) 366-8000

TO: Howard Steiner
cc: Bill Smith
FROM: Jim Dunlap
DATE: June 25, 1979
RE: Olympic Donation Media Update

TELEVISION	AUDIENCE	STATUS
1. Today Show (NBC) (6 minutes)	13 million	Aired 6/4/79
2. Sports World (NBC) (Hillary Cossell)	15 million	Scheduled for July filming in Colorado Springs
3. Newsweek Syndicated Broadcasting	17 million	Distributed to 71 stations 6/21/79 To be aired 7/1
4. WPVI-TV (ABC), Philadelphia	150,000	To be aired in August
5. The Human Body (CBS)	15 million	Segment to be done on Ariel and his work in Sept./Oct
6. Olympic Videotape	30 million +	To be distributed in mid-summer
7. Here's To Your Health (PBS)	10 million	To be aired in early August
8. WCVB-TV (ABC), Boston	150,000	To be aired in Ju
9. National Geographic Special	10 million	To be aired in No
10. WHYN-TV (ABC), Springfield	50,000	Aired 6/4/79
RADIO		
11. ABC Sports Radio Network (Gil Parmalee)	20 million 1600 Stations	Aired
12. Associated Press Radio Network	3 million 615 Stations	Aired
13. NBC Network Radio "Olympic Odyssey"	2 million 250 Stations	Aired

14. WNEW-Radio, New York	1.5 million	Aired
NEWSPAPERS		
15. New York Times	800,000	Ran 6/5/79
16. New York Times (Sunday)	1,400,000	Ran 6/10/79
17. New York Daily News	2,100,000	Ran 6/5/79
18. United Press wire photograph	1,000 newspapers	Ran 6/4/79
19. Boston Globe	660,000	Ran 6/6/79
20. Boston Herald-American	350,000	Ran 6/22/79
21. Associated Press (Bart Rosenthal)	1,350 newspapers	Ran 6/14/79
22. Colorado Springs Sun (N.Y. Times news service)	27,000	Ran 6/6/79
23. New Orleans Times-Picayune (AP)	212,000	Ran 6/5/79
24. Richmond Times-Dispatch (AP)	136,000	Ran 6/5/79
25. Monroe, La. Morning World (AP)	40,000	Ran 6/5/79
26. Wichita Eagle	122,000	Ran 6/5/79
27. Chicago Defender (UPI)	23,000	Ran 6/5/79
28. Quincy Patriot Ledger	75,000	Ran 6/5/79
29. Middlesex News	52,000	Ran 6/5/79
GENERAL MAGAZINES		
30. People	2,000,000	Late June, early July
31. The American Way	2,000,000	Late 1979
TRADE PUBLICATIONS		
32. Computer Business News	50,000	Ran 6/4/79
33. Electronics	90,000	Ran 6/7/79
34. Computerworld	83,000	Ran 6/18/79
35. Computer Business News	50,000	Ran 6/11/79
36. New England Advertising Week	5,000	Ran 6/1
37. Ad East		June Issue

TO : Bill SMITH
FM : Françoise LINDECKER
CC : Gull-May HOLST

Bill,

Here is some information on G. ARIEL presentations in Europe. First results.

I - IMMEDIATE IMPACT FOLLOWING PRESENTATION

A. TELEVISION x 1) 2) 3)

ENGLAND	BBC TV news BBC newsround	2 million 5 million
SWEDEN	National Evening news National Sport program	2 million 1.4 "
FRANCE	A2. National Evening News	5 million
ITALY	ANTENA NORD (Milan Area) TELE ALTO MILANESE (Private) RAI (National TV)	

B. RADIO x 1)

ENGLAND	104 BBC (National) Radio 4 Radio 1 (interview R. Piggott) BBC (London Area) Capitol Radio LBC	2 x 5 million 2 x 1.5 M. 1M. 240,000 4 x 500,000
SWEDEN	National morning news	
FRANCE	0,34 RMC (interview L. Fradin) 2,8 RTL (national coverage - morning news)	340,000 2.11
ITALY	No precise information yet.	
TOTAL 19 million		TOTAL ...

- x 1) Coverage numbers to come.
- 2) DG name has always been seen on screen.
- 3) Video copies will be available.

C. DAILIES

ENGLAND

GUARDIAN 05
Daily Mirror 3, 2
Financial Times 0, 2

SWEDEN
600 000

(Forget about the names!) the only
2 existing dailies reported following morning

FRANCE

L'EQUIPE (sport daily)

ITALY

(No answer yet) but I know articles published

D. PRESS : OTHERS

Many articles appeared in trade, electronic, sport and medical
press.
Good coverage everywhere.

II - FOLLOW UP

1. ENGLAND

Like to have G. ARIEL early December for a national meeting
to equip Great Britain Olympic Committee.

2. SWEDEN

No precise request yet.
Will take opportunities.

3. GERMANY

Exclusive report with ZDF. Expecting G. ARIEL on Nov. 10th
for interviews and demonstration live. Confirmation to come
on Nov. 5th.

4. ITALY

Urgent need for color pictures (as many as possible).
Feature article to come in "Science and Life".

5. FRANCE

Appointment with INS (National Institute for Sport). They
asked if Nov. 7th would be possible for G. ARIEL.

.../...