Future Think - The Wizard and his Magical Machines

Gideon Ariel puts the Computer to the Service of Sport


Future Think
The Wizard and His Magical Machines
Gideon Ariel Puts the Computer to the Service of Sport
Kent K. Gordis

Code	**adi-pub-01005**
Title	Future Think - The Wizard and his Magical Machines
Subtitle	Gideon Ariel puts the Computer to the Service of Sport
Name	Bicycling
Author	Kent Gordis
Published on	Thursday, July 1, 1976
Subject	ACES; Baseball; Discus; Exercise Machine; Favorite; Legal; Media; Olympics; Performance Analysis; Science; Shoes; Sports; Tennis; Track and Field; Volleyball; Wizard
URL	https://arielweb.com/articles/show/adi-pub-01005
Date	2013-01-16 15:40:43
Label	Approved
Privacy	Public

Future Think: The Wizard and His Magical Machines

This article by Kent K. Gordis explores the work of Gideon Ariel, a pioneer in the field of computerized biomechanical analysis. Ariel's work has greatly influenced the training of U.S. Olympic athletes since 1971. His devices and insights have helped athletes like Steve Ilcgg, a 4000-meter pursuit gold medalist, and the 1984 women's volleyball team. Ariel's work extends beyond elite athletes, as he has also contributed to the design of the Nautilus exercise machines.

Ariel's latest project is the creation of an ultimate exercise machine that adapts to each athlete's body form and range of motion. The machine provides instant feedback through a video monitor and is designed to be free of inertia and gravity. Ariel has also developed a computerized bike linked to a video monitor, which he first displayed at the Hilton Corporation Tennis Show in Los Angeles in late October 1984.

Ariel's work also involves comparing the dynamics of American athletes with Eastern Bloc stars, and he has expanded his fields of interest into footwear, developing a computerized shoe that calculates stress points on the foot. Ariel's work is characterized by his fascination with the human body and how it performs, and his refusal to take anything for granted.

This PDF summary has been auto-generated from the original publication by arielweb-ai-bot v1.2.2023.0926 on 2023-09-28 03:38:37 without human intervention. In case of errors or omissions please contact our aibot directly at ai@macrosport.com.

Below find a reprint of the 2 relevant pages of the article "Future Think - The Wizard and his Magical Machines" in "Bicycling":

The Wizard and His Magical Machines

Gideon Ariel Puts the Computer to the Service of Sport

Kent K. Gordis

In the future, the work of Gideon Ariel will affect how we train.

Since 1971, when he first brought his high-tech visions to U.S. Olympic track and field training camps, Ariel, an expatriate Israeli who's now an American citizen, has played what many consider to be the leading role in a budding field called computerized biomechanical analysis.

More recently, his devices and insights have aided U.S. Olympic athletes, including Steve Hegg, 4000-meter pursuit gold medalist, and the 1984 women's volleyball team, which won a silver medal in Los Angeles. In the future, marathon runners, joggers and tennis players may also benefit from his contributions.

Adviser to Olympians

The year was 1975. American discus thrower Mac Wilkins felt confident he could perform well at the upcoming 1976 Montreal Olympics. Yet his throws always seemed to fall shy of the standard established by the East Germans. Coaches and advisers tried to help, but to no avail. This is when Gideon Ariel, a one-time Olympic discus thrower for Israel and a scientist dedicated to studying sport, stepped in. He was sure Mac Wilkins could easily beat the East Germans.

Ariel was convinced Wilkins's problem resided in his throwing motion. Using high-speed motion picture cameras and sensors that linked Wilkins's body to computers, Ariel established that the athlete was buckling his leg as he threw the disc.

Made aware of the power-robbing flaw, Wilkins changed his form and went on to win the gold medal at Montreal with a world record throw of 241 feet.

Ariel's contributions to training have not concentrated solely on the elite, however. He gave a boost to the weight training boom when he used his computers to design the cam on the Nautilus exercise machines. Ironically, he eventually drew on his findings to question Nautilus developer Arthur Jones's claims that the machines exercise muscles in a complete range of motion.

"We found that the design of the cam is only a compromise," Ariel explained from his Tarbuco Canyon, California, research center. "If you swing the weights too fast, the cam will make them fly away from you. Jones claims that because of this you have to use the machines slowly — but this is forcing the athlete to adapt to the machine and not vice versa."

Ultimate Exercise Machine

As a result Ariel, 46, took on a project to create the ultimate exercise machine. He knew from the start he was looking for a machine with a computerized brain that would adapt to each athlete's body form and range of motion instead of forcing the trainee to change style to fit the device.

He also knew that instant feedback would be a necessity and decided to incorporate a video monitor into the apparatus. Perhaps most importantly, he designed the machine to be free of inertia and gravity.

"What we have is basically a hydraulically operated system that's controlled by a computer," he explained. "And if I put an athlete like a shot-putter on the machine, it can start with a certain resistance (that permits a range of motion of) 10 degrees per second, and end with another (that permits) 30 degrees per second. This kind of computer-operated machine will adapt to the velocities which are the most favorable to his specific activity. No other machine can do this."

Lest he appear biased, Ariel was quick to add that his device is not the only computer-operated machine capable of such feats.

He also paid a lot of attention to the quality of feedback that the athlete could review. "We developed two ways to see your results," Ariel continued. "The first way is to see your output on colored graphs. Or you can create a split screen with your output on one side and the world champion's output on the other."

He added that when videotapes of both the subject and the world's best are available, the monitor can show split screen images of the two athletes. The complete unit retails for $16,500.

Now Ariel, a Ph.D. in exercise science from the University of Massachusetts, is delving into the field of cycling.

"It's a great, fascinating sport, because of the complex interactions between the bike and the rider," he explained. "The equations involved in cycling dynamics are extremely complicated." Ariel noted that the added inertia and aerodynamic factors created by the bicycle contribute to the difficulty of analyzing cycling motions.

"But the hardest thing about cycling," he continued, "is simply the fact that the motions are in so many planes. As the cyclist pedals, he tilts the bicycle back and forth and into an infinite series of planes." Only with stationary bicycles can Ariel's team begin to analyze cyclists. But he laments: "This is not a very realistic situation."

Computerized Bike

Using the technology of his exercise machine, Ariel has developed a computerized bike linked to a video monitor. "Both machines are resistance mechanisms," he noted. "For the bicycle machine we simply added a bike where there was a bench before. Our basic goal with the bicycle machine was to measure what is the basically isokinetic* force of cycling. And on this machine the cyclist will be able to determine the force he or she wants to reach. Let's say he wants 60 percent of his maximum (force) and more resistance in the first 10 degrees than in the last 10 degrees of the pedal stroke. All he has to do is enter this information in the computer."

Ariel first officially displayed this computerized bike at the Hilton Corporation Tennis Show in Los Angeles in late October, 1984. The bicycle machine, complete with computer, will retail for $9,500. The bicycle device alone will sell for $4,500, he said. Its cost is significantly less than the exercise machine because it doesn't require the expensive hydraulics of the general exercise device, he added.

"We've already received 62 orders for (the cycling machine) and we haven't even introduced it yet," Ariel said.

Prior to the summer Olympics, Ariel worked with Raleigh and Steve Hegg in an attempt to arrive at the most efficient equipment design. "Raleigh came to me with that funny looking bike Hegg used at the Olympics," Ariel explained. "We worked on its structural and aerodynamic characteristics within the parameters of the 4000-meter pursuit."

During his research, he discovered that, when Hegg accelerates at the start of the event, the bike's small 24-inch front wheel doesn't touch the ground for the first three or four pedal strokes.

"We told him to lean over more to keep his front wheel on the track," he said. "The prob-

**characterizing activity in which the speed of motion remains constant although the force may change*

lem is, Steve's legs are so powerful, he could flip the bike over." Ariel added he has worked with Raleigh to design a new version of the "funny bike" that places more of the rider's weight over the front wheel, to hold it down.

Ariel's work has also brought him to study the question of saddle height. The generally accepted rule-of-thumb in the United States has been to place the heel on the pedal and raise the seat until the leg is fully extended. But when Cyrille Guimard, coach of the crack professional Renault racing team, took his riders thorugh a series of tests back in 1980, he found the optimal position to be 2.5 centimeters (about one inch) higher.

How does Ariel determine position?

"It is difficult to say," he conceded. "But it's true we've found a higher saddle usually results in more speed and force even if it's less comfortable." Ariel explained his findings metaphorically. "Everybody knows you can stand up with 500 pounds on your shoulders, but you can't squat with that much — it's a similar thing with saddle height."

The technique Ariel used to determine saddle height is straightforward. "At first we tried different heights at, say one-quarter inch increments. We measured the athlete's shank and thigh. Then we placed transducers on his legs and let him ride, with the computer calculating the data."

In these tests, close approximations of road riding were assured by placing the bicycle on rollers, rather than using a stationary bicycle, he added.

Pedal Power

The same tests have led to some interesting conclusions on the pedaling stroke. The most efficient stroke, he has found, involves keeping the ankle as perpendicular as possible to the primary range of motion. "But since this is a rotary motion, you really can't do that," he clarified. "You can't put your foot at a 90 degree angle to the primary motion when it's at the top or the bottom of the stroke — and to attempt it would be dangerous."

Ariel has determined that focusing force on the principal up and down strokes is usually the most effective method of pedaling. He also discovered that taping the ankles slightly can direct more of the cyclist's force into the vectors of the primary motion.

Ariel has also consulted with Shimano in their development of the aerodynamic pedals currently being sold on the American market.

Spying on the Soviets

Another major aspect of his work has involved comparing the dynamics of American athletes with that of Eastern Bloc stars. "But when, for example, we want to measure the dynamics of foreign athletes such as the Soviets, we can't wire them up because they obviously won't let us," he lamented. "So, we use the indirect method only."

Unlike laboratory tests that combine measurement of actual motion with computer transferred high-speed cinematography, Ariel uses only the second method with Iron Curtain athletes.

After filming the individuals under study, Ariel returns to his center where the film is isolated in one plane of motion and then projected onto a screen covered with a grid of hundreds of tiny microphones. Using a sonic pen linked to a computer, he pinpoints, frame by frame, the location of the athlete's limbs and other body parts. The computer then generates stick-figure representations of the athlete's motion.

Although he concedes the indirect method is not quite as exact, it has played a crucial role in bettering American performances in a number of sports, he said.

Fancy Footwork

In the past 18 months, Ariel has also expanded his fields of interest into footwear. He has been commissioned by the Pony shoe company, a subsidiary of Adidas, as a product researcher.

"We have developed a number of shoes for them," he noted, "including a computerized shoe that calculates stress points on the foot."

Ariel added that the shoe, currently used only for lab testing, might one day be marketed by Pony.

He has also developed a revolutionary marathon shoe. "Our tests showed that long-distance runners need a harder shoe. We are now developing a distance shoe with a two-part sole, one for the heel, one for the ball of the foot, for the best possible support."

In addition, Ariel has developed Pony's weightlifting shoe, which features a detachable sole that allows each competitor to add the appropriate height for his needs. Another shoe he's designed has an inflatable upper and would come in only three sizes, thus saving on inventory costs, he claims.

Feverishly Inventing

Meanwhile, Ariel is working with tennis instructor Vic Braden, chairman of the board at the center, to slow down the speed of tennis balls.

"The problem with tennis balls is that for the millions of average tennis players, the balls are too fast," Ariel emphasized. "For the average Joe who likes to play on weekends, the game is just too fast. So, at first we were involved in developing larger rackets. Now, we've been looking into slowing down the ball by making it larger and softer." Although illegal in competition, the slow ball has been a tremendous success with Braden's students, Ariel said.

He's also scrutinized the color of balls used in sports. "We've found that the color most people respond to is a dark orange or a light red. We've developed orange and red balls for tennis, volleyball, baseball and other sports."

From Mac Wilkins and the esoteric computerized research involved in improving his performance, to something as apparently mundane as determining the color of tennis balls, the two constants in Gideon Ariel's work have been his fascination with the human body and how it performs, and his refusal to take anything for granted. ○