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KEEPING SCORE

Scientists Take Swing at Golf Ball's Dimples

By NICHOLAS BAKALAR

It is safe to say that most golfers have not thought much about the little dimples on their golf balls. Fortunately, engineers at Arizona State University and the University of Maryland have been doing some thinking for them by creating a computer simulation of the way air flow affects a ball's speed and trajectory. It turns out that the design of those little indentations is more important, and more complex, than the average golfer may imagine.

Every golfer wants to play with the best ball he can find, but the United States Golf Association has rules, lots of them. The ball cannot weigh more than 1.620 ounces — yes, that is three decimal points. It must fall, under its own weight, through a 1.680 ring gauge in fewer than 25 of 100 randomly selected positions at a room temperature from 71.6 to 75.2 degrees. It must be spherically symmetrical. Its initial velocity and its combined carry and roll must not exceed precise limits, and the ball must be tested using equipment specified by the U.S.G.A. But there are no specifications for the size or number of dimples.

The organization regularly updates a list of more than 800 Conforming Golf Balls, those that have met the published specifications. So that there are no misunderstandings, it lists the identifying characteristics of every approved ball: the printed markings; whether its construction is two piece or three piece; liquid center or solid; single cover or double; its spin performance (when hit with a driver and with a short iron); the name of the manufacturer; and the country where it was made. It even tells what colors it comes in.

The list notes the number of dimples on each approved ball, but only as an identifying feature. The officially approved Rules of Golf makes no mention of dimples.

The way a ball behaves in flight depends on air flow, and air flow is affected by wind and weather, by the velocity and the spin of the ball, and by those dimples. No one controls the weather, and velocity and spin depend on the skills of the golfer. That leaves only the dimples.

Maybe one reason the rules do not talk about the dimples is that their effect is so difficult to measure. It is well known that dimples reduce drag — a ball with dimples flies farther than one without. But the number of possible dimple configurations is for all practical purposes infinite. Testing them by trial and error, which is the way manufacturers have always done it, means that very few possibilities have ever be tried.

But now a team of mechanical engineers has constructed a computer model of a golf ball's surface. The model simulates a golf ball moving through air, and allows the engineers to solve equations that describe air flow at more than a billion points across the ball's surface. Running a typical simulation requires a supercomputer — the equivalent of more than 500 networked desktop computers running in parallel for more than 300 hours. The result is a vast amount of data about the local speed and pressure of the air around each dimple and around the ball.

"We have a reasonable understanding of the effect of the dimples and the way they change local air -flow distribution around the ball," said Kyle Squires, a professor of mechanical engineering at Arizona State University. "We're now beginning to do some simulations where the ball rotates so that we can begin to understand what the ball does in real life."

Squires is part of a team that includes his graduate student Clinton Smith; Elias Balaras, an associate professor of mechanical engineering at the University of Maryland; and his doctoral student Nikolaos Beratlis. The group was to present its findings Sunday at a meeting of the American Institute of Physics in San Francisco.

The techniques involved can be applied to more significant problems than building a better golf ball. "What we're looking at is an application in flow control," Squires said. "That's an interesting problem in airplanes, gas turbines and other things. Being able to manipulate flow in a device is a common problem, and in some of those areas, changing the pattern on the surface could be very useful."

The design of the dimples also affects the direction a ball takes. "It's conceivable that we could design dimples that would lower the risk of a hook or a slice," Squires said.

Can the engineers actually find the ideal dimple pattern? Steve Ogg, a vice president at Callaway Golf in charge of golf ball research and development, is dubious, even if they are using a very good simulation program.

"We design experiments that vary the geometry of the dimples systematically," he said. "It's not trial and error — it's a scientific experiment."

The computer simulation these researchers are using, he said, "is a resource, and they'll end up learning something from it, but it would be very difficult to design a golf ball with it."

In any case, Squires is pretty sure there is room for improvement.

"There are an infinite number of patterns, and we can't test all of them," he said. "But we'll certainly be able to come up with a better pattern. Why would we expect that the best pattern is on the shelf now?"

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