Computer simulations may help golfers tame the sport's 'scariest 155 yards'

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Rajat Mittal, left, a Johns Hopkins mechanical engineering professor, and Neda Yaghoobian, a visiting postdoctoral scholar, devised a computer simulation to determine how wind conditions affect the of trajectory of a golf ball in flight. Credit: Will Kirk/Johns Hopkins University

Johns Hopkins engineers have devised a computer model to unravel the wicked wind conditions that plague the world's greatest golfers at the course that hosts one of the sport's most storied tournaments, The Masters, in Augusta, Georgia.

Rajat Mittal, an aerodynamics expert and professor of mechanical engineering in Johns Hopkins' Whiting School of Engineering, who also describes himself as a recreational golfer, developed this system with Neda Yaghoobian, a postdoctoral visiting scholar on his lab team. Yaghoobian earned her PhD in mechanical engineering at the University of California, San Diego, focusing on urban energy and microclimate, as well as atmospheric and environmental flow research. She presented the team's early findings in November at the 68th annual meeting of the American Physical Society Division of Fluid Dynamics.

Yaghoobian's recent research examines the significant role that wind conditions can play in golf. In her APS presentation, she reported that she and Mittal had devised a model based on computational fluid dynamics that incorporates wind conditions and information on local tree canopies to evaluate—and even predict—how the wind's direction and speed are likely to affect the accuracy of a golf shot on any particular hole. The researchers also used computer simulations to explore the impact that factors such as spin and launch angle have on the ball itself as it travels toward its destination.

For their proof-of-concept research, the team collected data from the notorious 12th hole at Georgia's Augusta National Golf Club, site of the annual Masters Golf Tournament. Although this par-3 hole is the shortest on the course, it is subject to unpredictable winds that swirl over and around the tall tree canopies that surround the hole. It also features water, sand and a particularly small green that compound its complexity.

A 2012 Golf Digest article about Augusta National's 12th hole dubbed it

"the scariest 155 yards in golf." The story described how even the world's top golfers often misjudge the wind conditions, leaving shots short into the water or sometimes overshooting the green clear onto a different golf course next door.

To help gauge wind conditions, golfers often throw a tuft of grass in the air. But Mittal and Yaghoobian collected and processed more precise scientific data. In addition to local weather records—particularly wind conditions—they also gathered information about the topography of the hole and about its plant canopy. Their computer simulations showed that the tall trees surrounding the 12th hole do indeed have a significant impact on the accuracy of a golf shot. They also found that winds from certain directions are the most dangerous for this hole.

"Our primary goal was to develop a computational tool that could integrate all of these kinds of information to see if it can help predict how the wind will influence a golf ball's flight on a difficult hole like this one," Mittal said. "This level of analysis has not been available to golfers. But in our early work, we've been able to demonstrate proof-of-concept that it is possible to generate these kind of detailed predictions about a particular golf hole."

Eventually, the researchers say, the system might be incorporated into a portable device or application that could help advise golfers about what club to use, how hard to hit the ball and how best to aim the shot, all based on a hole's weather conditions, terrain and other factors. "We think that this prototype system is a promising first step toward an app or software program that could help golfers, course designers and even sports commentators," Mittal said.

Yaghoobian added. "I really knew very little about golf when I started on this research, but having worked on this project for over a year now, I have come to appreciate the inherent complexity of this sport."

Working with the Johns Hopkins Technology Ventures staff, Mittal and Yaghoobian have obtained a provisional patent covering the computational tool developed for this project.

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