

Researcher analyzes acoustic properties of golf club drivers

August 10 2016, by Stefanie Tomlinson



Peter Kerrian addresses a golf ball as he prepares to record the impact sound produced by the driver and golf ball in an attempt to understand the differences in the sounds produced by drivers. Credit: Penn State

Two years ago, acoustics graduate student Peter Kerrian started playing

golf after years of watching PGA tournaments on television. Now, his hobby has provided him an opportunity to help understand the design of golf clubs.

When a popular golf club manufacturer approached Penn State's PGA Professional Golf Management program about an issue with a particular club, Dan Russell, professor of acoustics, recruited Kerrian to conduct the research.

The problem, explained Kerrian, was that the golf community perceived the drivers as too loud and, as a result, quite "annoying."

"Golfers weren't particularly enjoying the sounds the club made when they struck a golf ball, even though it had recently been designed to increase the moment-of-inertia of the club, making it more forgiving to hits off center resulting in straighter ball trajectories," said Kerrian.

The current trend of golf club manufacturers, explained Kerrian, is to incorporate composite materials into the drivers. These lighter weight materials allow for adjustable mass features to be designed that enable players to adjust the performance of the driver.

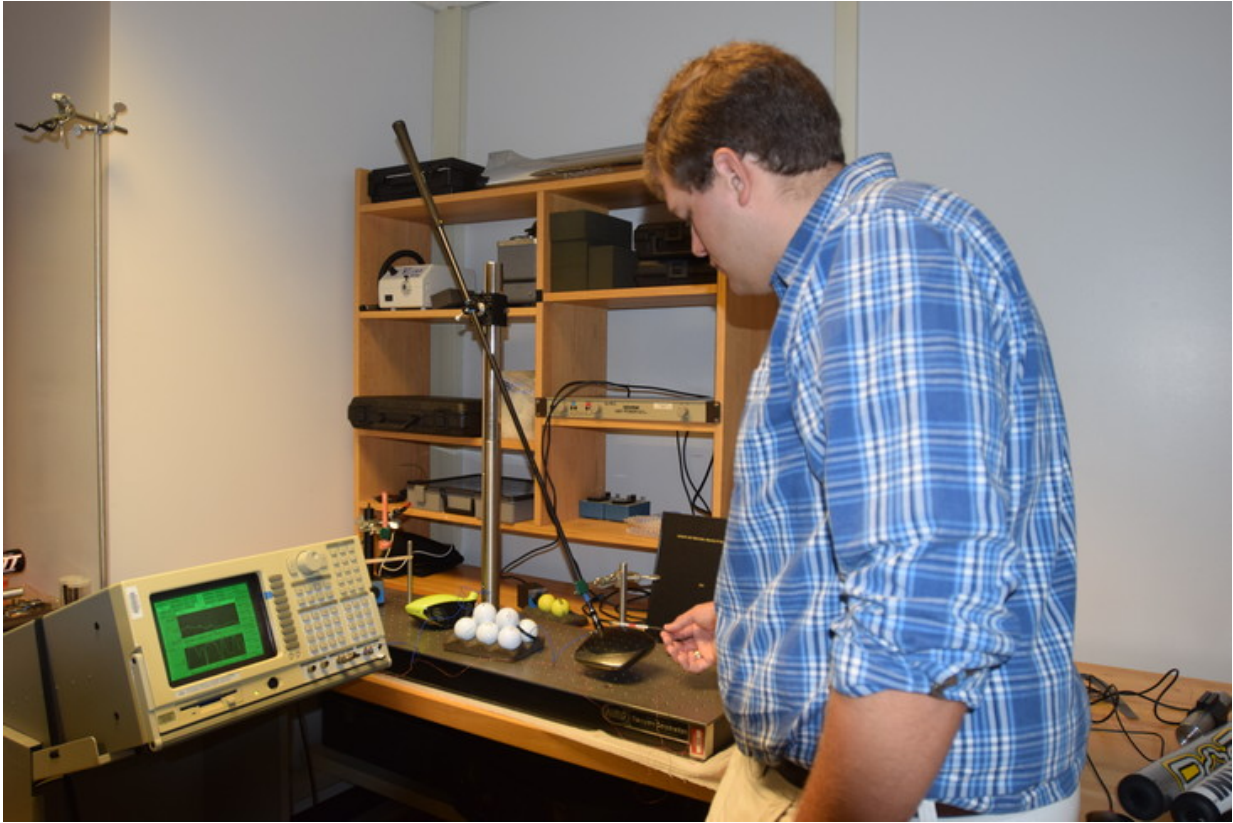
However when these composites are introduced, said Kerrian, the result is that some of the clubs aren't making enough [sound](#).

So, Kerrian set out to utilize the field of acoustics to better understand the problem.

"The first step to understanding the sound a club makes is to identify the club head vibrations, because those vibrations contribute to what is heard," said Kerrian.

In a lab in the Research West Building, Kerrian performed an

experimental modal analysis called a roving impact hammer test.



Peter Kerrian taps different points on a driver during a roving impact hammer test in Research Building West. Credit: Penn State

"I placed an accelerometer on the clubs, then took a small impact hammer and excited different points on the face, crown and sole of the drivers. The accelerometer measured the vibration from each impact. After the data was imported into the computer, the post processing software extracted the mode shapes. Each mode shape occurs at a particular frequency and illustrates how the club would vibrate at that frequency," explained Kerrian.

The second part of Kerrian's research involved taking sound recordings of the clubs in order to figure out at which frequencies the club was radiating sound. These tests were completed at the Penn State Golf Course.

"Eric Handley, senior instructor in the PGA Golf Management program, and one of his students, Ryan Hager, were kind enough to assist us with swinging the club. It was crucial to have a golfer who would swing the clubs with consistency to ensure accuracy of the data we were collecting," said Kerrian.

"In order to find out what frequencies were involved in the sound, we looked at which mode shapes corresponded to the peaks that we were seeing in the acoustic spectra. We concluded that those mode shapes were responsible for the sound produced at impact," said Kerrian.

The results of the work were the subject of Kerrian's thesis for his Master of Science in Acoustics, which he earned in May 2016.

Kerrian also discussed his findings in a talk titled "The Problem of the Noisy Driver" and received an Acoustical Society of America Structural Acoustics and Vibration Technical Committee Best Student Paper Award at the society's Spring 2016 meeting May 23-27 in Salt Lake City, Utah.

Implications resulting from his study may help explain the different sounds produced by the various [golf](#) club drivers.

"Golf club manufacturers could use the vibration results to understand which mode shapes might radiate sound during club development," said Kerrian.

He cautioned, however, that finding the "perfect" sound is not an easy

task.

"It's a very open ended question because every golfer has their own individual preferences of what a [club](#) should sound like," said Kerrian.

Provided by Pennsylvania State University

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