DETERMINING OPTIMAL LAUNCH AND SPIN TO MAXIMIZE DRIVER DISTANCE

Chris Broadie[1*], Erik Henrikson[1]
[1]Engineering Department, PING, Inc, Phoenix, AZ 85029, USA
email: chrisbr@ping.com

Introduction

Maximizing driver distance is an important part of lowering golf scores. At the amateur level, lower handicaps are correlated with longer driving distances. On the PGA Tour, Broadie estimated that increasing driving distance by 20 yards lowers scores by 0.7 strokes[1]. This abstract specifically focuses on what launch conditions would allow golfers to maximize their driving distance potential. From a trajectory model perspective, high launch and low spin clearly is optimal for distance. However, many very successful golfers have much lower launch and higher spin than is suggested by a trajectory model. This abstract looks at how an impact model and trajectory model can be combined to determine more practical driver launch and spin recommendations for all golfers.

Methods

An impulse momentum model is used to predict launch conditions for a given club delivery[2]. A trajectory model then uses the launch conditions from the impact model to predict carry and total distance for the simulated golf shot[3]. The loft of the simulated club can then be adjusted to determine the loft and resulting launch and spin that maximizes distance. Figure 1 shows an example for a player with 113 club speed and -1.5° angle of attack (AoA); their carry distance is maximized at 10.4° launch angle and 2,760 rpm spin. This process is then repeated for 80-180 mph ball speeds (club speed is assumed to be ball speed / 1.49) in 10 mph increments and -10° to +10° attack angles in 1-degree increments.

Results and Discussion

Figure 2 shows the driver optimal launch and spin values predicted from the impact and trajectory models. The takeaway for fitters is that the optimal spin rate is primarily driven by a golfer's angle of attack. For example, at -10° AoA and 120-180 mph ball speed, each optimal spin rate is between 3,450 and 3,550 rpm. The optimal launch angle depends on both angle of attack and ball speed. At 0° AoA, a shift from 80 to 180 mph ball speed changes the optimal launch from 18.8° to 10.4°. Similarly, at 150 mph ball speed, a shift from -10° to 10° AoA changes optimal launch from 6.2° to 19.3°. Therefore, when fitting for driver loft, there is no single launch and spin prescription for everyone; variations in ball speed and angle of attack are the two primary variables that determine each golfer's unique optimal solution. Further refinement to the recommended optimal launch and spin depends on the golfer's playing conditions such as temperature, altitude, fairway firmness and carry vs. total distance preference.

Significance

Results from this study provide useful guidelines for fitters and golfers to understand optimal launch and spin on drives. This abstract addresses a common misconception that everyone needs high launch and low spin. Surprisingly, low launch and high spin is the optimal solution for golfers with negative angles of attack.

Acknowledgements

The trajectory and impact models use proprietary tuning from PING, Inc. research.

References

1. Broadie, M. Every Shot Counts; Penguin Books: New York, NY, USA, 2014.
2. Danaei, B., McNally, W., Henrikson, E., and McPhee, J. "Adjusting a Momentum-Based Golf Clubhead-Ball Impact Model to Improve Accuracy"
3. Quintavalla, S.J. "A generally applicable model for the aerodynamic behavior of golf balls"

Figure 1: Simulated launch angle vs. carry distance

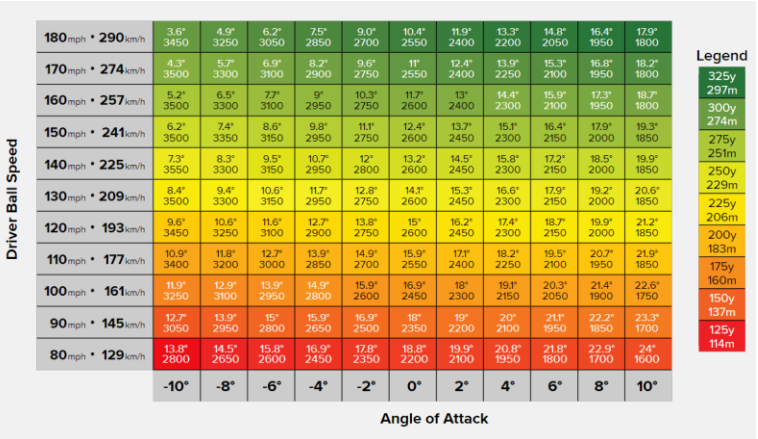

Figure 2: Optimal launch and spin guidelines for different ball speed and AoA